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The American Society of Mechanical Engineers' Meeting and the Vote.

The annual convention of the American Society of Mechanical Engineers, which was held last week, was much the same as those that have preceded it, except that one question aroused far more interest than is usually manifested in the society's affairs. Needless to say that question was the proposed increase of dues. The proposition was defeated, as we firmly believe it deserved to be, and we think the general opinion is that at no previous time was the propriety of defeating it so clearly apparent as it was at the meeting after the arguments pro and con had been presented.

Even a member of the Council who had approved the measure expressed the hope that it would be unanimously defeated, and many others of those who were willing to admit that the society might possibly use a larger income advantageously thought it advisable to wait until a better understanding of the situation could be gained as a result of the thorough investigation which seemed to be unanimously demanded.

It is safe to say that the interest in this question was much stimulated by the knowledge that every member who desired to do so could vote upon the question and although nearly 1,000 members failed to vote for one reason or another, still far more of them voted than usually vote upon any question whatever. There can, we think, be little doubt that interest in the society's affairs will be stimulated by the proxy idea. A member who lives a long distance from New York and seldom attends a meeting and who has no vote except for new members and for a list of officers whose nomination is equivalent to an election, inevitably feels that he is shut out by circumstances from anything like a full participation in the affairs of the society and he unavoidably loses interest in it. Practically as things have been he has been unable to affect the society's affairs in anyway. All he had to do was to send in his $15 each year and in return for this get the volume of "Transactions." Undoubtedly most members who have been voting heretofore have wished that participation in the society's affairs might be more general, but no way of securing it seemed possible.

On the other hand, one member of the Council—F. H. Boyer, of Boston—became somewhat hysterical over what he seemed to imagine was an invasion by people who had no right to express an opinion and by members of the society who had no right to vote upon its affairs. He lampooned the technical press—said the editors were ignorant of the matters they discussed and that the members who had sent in their proxies were also ignorant of the society's affairs. He spoke of the proxies as though they constituted a baneful force preventing those who, like himself, really understood the society's affairs, from conducting them in the best way; finally remarking with much indignation: "If it had not been for this proxy business this amendment would have gone through," thereby unwittingly paying the present writer and the "American Machinist" one of the highest compliments they have ever received. Unless Mr. Boyer is gifted with a keener sense of humor than we give him credit for, he probably does not appreciate the ludicrousness of the position he placed himself in, especially when, as was shown within the next few minutes, any lack of information possessed by the members was due to the Council of which he is a member, and in fact that ignorance was shared by the Council itself until within a very few weeks past. It looked very much as if Mr. Boyer was angry because he knew that the members were going to prevent an increase of dues, which increase he had hoped would be endorsed by the members attending the meeting without much, if any, investigation of the real need of it.

Though perhaps there may have been other officers or members that held the same views regarding the perverse wickedness of members of the society being allowed to vote upon their own affairs, it is probable that there were very few of them present, and certainly no other expressed such views in open meeting.

On the other hand and in strong contrast, was the manly, courteous and straightforward statement of Henry R. Towne, of New York, giving full recognition of the right of members generally to be heard. His address was distinctly businesslike and did more than anything else probably to calm the troubled waters.

We feel bound to say, however, that Mr. Towne took upon himself and upon the Council more blame for the present condition of affairs than properly belongs to him or the Council. The Council ought not to be expected to dig into details of the society's management. Its function is broadly supervisory, and the work of really managing the affairs of any such society must necessarily be done by the man who is paid for doing it. Otherwise it will go undone and nothing else can be expected. In this case that man is the secretary of the society, who entirely escaped criticism in the meetings, probably because his office is not elective but appointive, and the Council was considered to be responsible for him and his administration, the curious feature of the case being that outside the sessions and in private conversation among the members the situation was just reversed and the secretary seemed to be more criticised than the Council.

We have sought to avoid doing more at this time than to simply reflect the spirit of the meeting. We think an overwhelming majority of the membership are and will continue to be very glad that the amendment has been defeated, and now the question comes up as to what should be done. It is quite obvious that the society cannot go on in its present course. Some changes are inevitable. The Council by adopting a resolution to appoint a committee to make a thorough investigation and report, to have the society's property appraised and to secure the adoption of a system of bookkeeping that will enable readily understandable and complete statements to be presented to the members every year has, we think, adopted a wise course and will, we hope, still further show its wisdom by securing the appointment on that committee of one or more active members representing the sentiment of the membership of the society as brought out and expressed in the recent

discussion and vote. In the meantime judgment may properly be, and we suppose will be, generally suspended.

The Strength of Beams.

We begin in another column the publication of a short series of articles on The Flexure of Beams, which, for the first time in many years, breaks new ground. The analysis and presentation of this subject in treatises and text books are almost stereotyped. No important contribution to the stock of knowledge of the subject has been made for many years, the chapter being apparently closed, and this in spite of the fact that certain methods of action and of failure of beams are well known, though not recognized in any existing formula. The study of the failure of beams by the buckling of the compression side has been strangely neglected, and now that it has been taken up, it proves to be the central fact and key to the entire subject when looked at in the broadest sense.

The analogy of the failure of the compression side of a beam by buckling to the method of failure of a long column was, of course, long ago remarked, but we believe there has been no previous attempt—certainly no successful attempt—to connect the two by a formula. Mr. Guy's experiments have been successful beyond any reasonable expectation in connecting them and in showing that Euler's formula for long columns is, in fact, the fundamental formula which lies at the base of the whole subject.

We believe there is not in any existing text book a formula by which the strength of a long beam unsupported sidewise may be determined, nor is there even a suspicion expressed that such a formula is possible; the general belief, until now, being that it is not possible. Mr. Guy discloses the laws of failure in this manner for the first time, and they are in consequence entitled to be called, as we shall hereafter call them, Guy's laws. The disclosure of such laws alone would be a notable achievement, but when to this is added the connection through definite formulas of long beams and columns, including inclined beams acted upon by vertical forces, the accomplishment is nothing less than exceedingly brilliant.

Mr. Guy's articles are a distinct and notable addition to the science of engineering, and we consider that to be the means of their publication is a rare privilege.

The laws disclosed are extremely simple and are shown directly from the results of the experiments. Contrary to what might be supposed from the introductory discussion of the limitations of existing formulas, the significance of most of the experiments can readily be followed by those with limited mathematical training Later on, when the discussion of the full significance of these laws is taken up, the work becomes somewhat mathematical, but, as far as possible, Mr. Guy has endeavored to divert his work of mathematics. The articles can be read by anyone who is acquainted with the usual treatment of the strength of beams, while the account of the experiments and the immediate deductions from them may be read by all.

The Premium Plan in Great Britain

An illustration of the serious manner in which the premium plan is regarded in Great Britain is given by a pamphlet published by Barr & Stroud, of 250 Byers road, Glasgow, for distribution among their employees in order to explain the system to them before putting it into practice. The pamphlet first explains the shortcomings of the day's work, piecework and profit-sharing plans and then goes on to show how the premium plan overcomes these shortcomings and how employer and employee share in the gains made under it. The pamphlet covers but eight pages, and is a brief and excellent explanation of the whole matter.

A Test of Steam Pipe Coverings.

A test of steam-pipe coverings has recently been made by Mr. George H. Barrus at the new power house of the Manhattan Elevated Railway Company in this city. The test was a thoroughly practical one on a sufficiently large scale and extending over time enough to give results to be relied upon. At the conclusion of the test a number of engineers and others interested were invited to look over the apparatus employed and Mr. Barrus read to them an able and interesting account of the arrangements in detail and of the results arrived at. Space will permit us to here present only a brief abstract of the results given in the paper. The measure of the efficiencies of the various coverings was in the weight of water condensed in each of a number of pipes, each covered with a different heat-insulating covering, but with all other conditions as nearly alike as it was possible to make them. The coverings chosen were those which are sold for the purpose, all bought without special selection. The condensation in the pipes without any covering was also measured, and the comparison of this with the results from the protected pipes showed the great value of the coverings. In general it may be stated that the condensation from the covered pipes was less than one-quarter of that from the bare pipes, while the differences in the condensation between the different coverings was so small as to practically leave little to choose between them. It will be noticed from the tabulated results which follow that the condensation in the covered 2-inch pipes was greater at the lower pressure, while with the bare pipes this result was reversed. The results from the larger pipes showed a greater difference in the efficiencies of the coverings and also a greater difference between the covered and the bare pipes. It was found that the condensation was the same whether the steam was stationary in the pipes or flowing at different velocities. A great many details, not hinted at here, were gone into for the purpose of securing reliable results and identical conditions, and the test as a whole entailed a large expense which the engineering world should appreciate. A brief summary of the results follows:

MINIMUM AND MAXIMUM RATES OF CONDENSATION PER HOUR FOR EACH OF THE COVERINGS TESTED.

	Minimum	Maximum
2-INCH COVERINGS 80 POUNDS PRESSURE—LENGTH OF TEST PIPES 100 FEET.		
Johns' Asbestocol	13.46	14.07
New York Air Cell	13.88	14.14
Carey's Molded	14.18	15.00
Johns' Molded	14.15	15.07
Gast's Ambler Air Cell	14.00	15.14
2-INCH COVERINGS 150 POUNDS PRESSURE—LENGTH OF TEST PIPES 100 FEET.		
Johns' Asbesto-Sponge Hair Felt, 3-ply	10.47	10.93
Johns' Asbesto-Sponge Hair Felt, 2-ply	11.21	11.39
Asbesto-Sponge Felted (Sectional)	11.20	11.57
K. & M. Magnesia (85 per cent. carb. of magnesia)	11.64	12.80
Asbestos Fire Felt (Navy Brand)	13.18	14.00
10-INCH COVERINGS 150 POUNDS PRESSURE—LENGTH OF TEST PIPES 35 FEET.		
Johns' Asbesto-Sponge Felted	10.67	11.07
K. & M. Magnesia (85 per cent. carb. of magnesia)	13.00	13.64
Asbestos Fire Felt (Navy Brand)	14.00	14.64
Watson's Imperial	15.79	15.93
BARE PIPES.		
2-inch 80 lbs. pressure	55.75	60.30
2-inch 150 lbs. pressure	71.78	72.20
10-inch 150 lbs. pressure	105.09	112.00
Temperature air of Room (Approx.)	50.00	75.00

Now it is the Crown Oil Company.

Another new name for the unfortunate Cleveland oil dealers is that of "The Crown Oil Company" (of Cleveland, O.), "The Crown Oil Company's" difficulty with its shipments of oil seems to be a little different from those of the others. They state in a proposition sent to the Graham Machine Company, of Monongahela, Pa.; "We are holding a barrel and a half-barrel of our highest grade of cylinder oil in your State on account of an error of our shipping department sending the oil into the wrong State," and which rather than have it returned they offer to sell at a low price. The letter is palpably printed on a printing press, the address only being filled in with the typewriter, which, of course, indicates that "The Crown Oil Company" is ex-

ceedingly unfortunate with its oil shipments and that so many of them are sent into the "wrong State" that they find it necessary to print the letters announcing such shipments and consequent reduction of price. In a postscript to this letter they request the party addressed if not interested to kindly hand it to those who are, and the Graham Machine Company remark that the "American Machinist" is probably as much interested as anyone else and consequently they send it to us and we add it to our already very large collection of similar documents.

Technical Publications.

"The Mechanical World Pocket Diary and Year Book for 1902." 278 4x6-inch pages, with numerous illustrations and tables. The Mechanical World, Manchester, England. Price, sixpence.

We have had occasion to notice this pocket book in its previous annual editions, and can only repeat what we have said before—that it contains an astonishing amount of information in the form of rules, tables, data, etc., and that it is published at an astonishingly low price.

"Smoley's Tables." Containing parallel tables of logarithms and squares of feet, inches and fractions of inches expressed in decimals of a foot and advancing by 1-32 inch from zero to 50 feet. By Constantine Smoley. 212 4¾x7-inch pages. The Engineering News Publishing Company, New York. Price, $3.

The object of these tables is to save the repeated conversion of dimensions given in feet, inches and binary fractions to feet and decimals of a foot, and *vice versa*. Thus if the diameter of a circle is given in feet, inches and binary fractions, its logarithm may be found directly from this dimension as given, and the sum of this logarithm and of the logarithm of π may be read directly back to the circumference in feet, inches and binary fractions. Similarly in problems involving the squaring of dimensions, the squares may be read in feet and decimals from the dimensions in feet, inches and binary fractions. The book is well printed on excellent paper, and is strongly bound in leather to withstand the thumbing due to hard usage.

"Outlines of Electro-chemistry." By H. C. Jones. 106 7x10-inch pages, with 13 illustrations. New York: The Electrical Review Publishing Company; The D. Van Nostrand Company. Price, $1.50.

In no field, probably, is the application of electricity at the present time making greater progress than in electro-chemistry and electro-metallurgy, and in none is a future of still greater progress more assured. The application of electricity to metallurgy has attracted less general attention than have others because, from the nature of the case, it has been less spectacular and of less direct interest to the public. None the less it is one of the most striking developments now going on, and the author has done well in producing this book which, while not a systematic treatise, "takes up several of the most important chapters in electro-chemistry and deals with them more or less fully." The book may be described as a foundation of the theory of this, in an extended industrial sense, new art.

"Electrical Engineer's Pocket Book." By H. A. Foster. 987 4x7 pages, with numerous illustrations, tables and diagrams. D. Van Nostrand Company, New York. Price, $5.

In the words of the preface, this book has been prepared because electrical engineering "has now reached a stage which renders necessary some manual that will be of assistance to the active worker in the various branches."

The author has not attempted to cover the entire field himself, but has secured the co-operation and assistance of well-known specialists to the number of eighteen who have revised various sections. Under these circumstances the book could hardly fail to be what it is, an eminently satisfactory digest and compend of those rules, tables and data which the engineer needs to have at hand.

The book will no doubt take its place alongside of "Trautwine" and "Kent," with which its mechanical execution is in substantial uniformity. The paper, press work and binding are an evidence of a determination on the part of the publisher as well as the author to make a book which should be worthy of its subject and its opportunity.

Commercial Review.

New York, Monday, Dec. 9.

MARKET AND INDUSTRIAL NEWS.

The matured condition of machinery market activity noted in previous articles receives confirmation in additional reports that have come to note in the last few days from engine builders' representatives and others. The December abatement of trade is almost due, but there is little sign of it as yet and indications are that it will amount to less than usual. The outlook for the new year is everything that could be desired. That 1902 can show such an improvement over 1901 as 1901 did over 1900 is not to be expected, but conditions are favorable to all the business that the country's capacity will justify. On stock supplies, such as bar iron and machinery steel, there is a faint disposition toward hesitation in demand, less than is normal to December. A stiffening tendency in the price of machinery steel shows the general strength of the market. A local steel man who has just returned from a trip to Birmingham, Ala., testifies with enthusiasm to rapid increase of manufacturing industries that is taking place among the iron-teeming hills of that region. He seems to think that there is enough independent ore there to break the lock in case the steel trust should attempt to form a jam of the iron-mining properties which it controls.

Providence, R. I., is no exception to the activity in machinery building that prevails generally throughout the country. The Brown & Sharpe Manufacturing Company, the Builders' Iron Foundry and the Diamond Machine Company, for instance, are more than busy.

Bids were opened December 3 for a quantity of machinery, etc., for the Puget Sound naval station. Among the articles called for was a 10-ton electric traveling crane, the lowest bidders on which were Pawling & Harnischfeger, Milwaukee, at $3,500 (also $4,000). On an overhead runway for electric traveling crane the lowest bidder was the Penn Bridge Company, Beaver Falls, Pa., at $7,987. The Grafton & Knight Manufacturing Company, Worcester, Mass., put in the lowest bid—$2,565.67—on a quantity of belting.

The Brown & Sharpe Manufacturing Company, which quite lately completed a new machine shop building and a few weeks ago set in operation an additional power plant containing a large Rice-Sargent engine, is now at work on a foundry, the extreme dimensions of which will be 360x360 feet. A novel feature of this foundry is a series of arched vaults built of Portland cement concrete and containing twenty-four chambers, the total length being 200, the width 40, and hight 17 feet. The roof of each vault has three manholes through which sand, etc., will be dropped to the level of the foundry floor. On the top pig iron will be kept and transported thence in cars over a bridge to the cupola charging floor. The new foundry will have more than three times the capacity of the present one, which is not a small one.

The Brown & Sharpe Manufacturing Company has opened an office in Philadelphia at No. 444, "The Bourse."

The Delaware, Lackawanna & Western Railroad has placed an order for sixty large locomotives with the American Locomotive Company.

It is announced that the negotiations to form a steel plate combine have been called off.

The Baldwin Locomotive Works are at present purchasing machine tools quite liberally.

A new company has been organized in Western Pennsylvania which, it is said, has secured the American rights and will manufacture the Willans central valve engine of the Willans & Robinson Company, Ltd., Rugby, England. The concern is called the Bradley Manufacturing Company and its organizers are C. H. Bradley, Jr., Pittsburgh, and D. J. Geary, Oil City. A plant will be erected in the Pittsburgh district.

One of the promising new enterprises in the East at present is the establishment of a plant by the Convertible Car Company, which is negotiating with a view to locating at Wilkesbarre, Pa. This car is one which can be quickly changed from a closed to an open car or *vice versa*, and is adaptable to either street railways or steam roads. The company has received orders, has had cars built by contract and possesses good export prospects, but wants a plant of its own. The proposed shop is 120x300 feet, with electricity as a motive power.

The force with which the depression in Germany has taken hold on that country may be judged from the fact that only 20,600 men are employed in metal trades this season within the scope of a certain investigation where 73,100 were employed in October, 1900. The working hours have been reduced in half of the factories. The unemployed in the larger towns amount to from 7 to 10 per cent. of their population and the aggregate of unemployed in Germany reaches 500,000 men, or 4 per cent. of the total number of artisans in the country.

The Census Bureau has given out preliminary reports showing the increase of manufacturing industries from 1890 to 1900 in the States of Minnesota and Illinois. The report for Minnesota shows: Capital invested, $165,832,246, increase of 30 per cent.; number of establishments, 11,114; wage earners, 77,234; annual wages $35,455,125; value of products, $262,655,831, increase since 1890 37 per cent.; cost of materials used, $173,425,615, increase 46 per cent. The industries of Minneapolis have grown about twice as rapidly as those of the rival city, St. Paul.

The statistics for the State of Illinois show for the decade from 1890 to 1900 the following changes: Number of establishments increased from 20,482 to 38,352, 87.2 cent.; capital from $502,004,512 to $776,829,598, 54.7 per cent.; average number of wage earners from 280,218 to 395,119, 41 per cent.; total wages from $142,873,265 to $191,510,962, 34 per cent.; miscellaneous expenses from $79,515,193 to $130,876,318, 64.6 per cent.; cost of materials used from $529,019,089 to $739,788,740, 39.8 per cent., value of products, including custom work and repairing, from $908,640,280 to $1,260,382,877, 38.7 per cent. For Chicago alone the increases were: Number of establishments from 9,977 to 19,203, 92.5 per cent.; capital from $359,739,598 to $534,000,689, 46.4 per cent.; average number wage earners from 190,621 to 262,609, 37.8 per cent.; total wages from $104,069,992 to $131,084,638, 25.9 per cent.; miscellaneous expenses from $43,235,427 to $80,414,817, 36.0 per cent.; cost of materials used from $409,493,027 to $538,401,562, 31.5 per cent.; value of products, including custom work and repairing, from $664,567,923 to $888,651,995, 33.7 per cent.

A committee of the Merchants' Association of New York appointed to study the Bankruptcy Act, has just completed its labors and rendered its report, which has been unanimously approved by the Board of Directors. The report approves of the Ray bill in the main, but recommends some amendments. It approves of the section intended to permit every creditor to retain all moneys paid to him by the bankrupt even within four months of bankruptcy, unless the creditor had reasonable cause to believe that the bankrupt intended to give him a preference by the payment. It suggests the insertion of clauses refusing a discharge in bankruptcy where debts amount to $5,000 if the bankrupt has not kept suitable books of accounts; also refusing a discharge in bankruptcy brought on or contributed to by rash and hazardous speculations or by unjustifiable extravagance in living, or by gambling, or by culpable neglect of his business affairs.

CHICAGO MACHINERY MARKET.

In the electrical machinery trade there is but one report: a continuance of the previous activity. The nearness of holidays and of the inventory season is unappreciated, for the lull that usually comes at this time is nowhere encountered in this branch of industry. The representative of one Western producer of electrical machinery remarks that in ordinary times they can make delivery of a 10 horse-power motor in two weeks at the outside; now they are asking forty-five days. They have an addition to a plant under way, and when it is completed better shipments may be made, but even this may be in doubt, for the growth of demand is on the whole more than keeping even with the growth of producing facilities, so that the situation from a market standpoint does not ease up a particle.

Electrical engineers have more work offered than they can accept. It is true that they use a fine discrimination in the choice of the work they retain, tying up to those concerns that have ample capital behind them and passing on to their neighbors the inquirers who have to finance as well as to perfect mechanically their plans. The amount of street railway work in sight is large. Ohio and Michigan are perhaps the Western leaders in this respect, but Indiana is a close third, and there are other centers of activity. A most interesting and novel electrical installation will be that at Lockport, on the Chicago drainage canal, for which bids have been asked. The plans contemplate, besides lighting and power, the heating of an entire building from the current generated at the falls.

The packing industries continue among the largest and most persistent buyers of electrical power. Armour & Co. have purchased an equipment for a new packing house at East St. Louis, Ill., consisting of one 1,000 and one 500 horse-power generator, to be furnished by J. Holt Gates, representing the Keystone Electrical Company, and about 150 motors of 1,400 aggregate horse-power from the Crocker-Wheeler Company. It is said that Armour & Co. will also construct a new plant at Fort Worth, Tex., requiring an electrical equipment of similar size. The Crocker-Wheeler Company has furnished the equipment for the new Cudahy & Co. plant at Kansas City. All the old packers are adding steadily to their electrical machinery and several large contracts are in prospect.

Deere & Co., Moline, Ill., will in a few days close for an electrical plant, consisting of a 1,200-kilowatt generator and about 2,000 horse-power in motors. The Chicago, Burlington & Quincy road has just bought a number of additional motors for their shops at Aurora, Ill., and the National Lead Company, of this city, has been a buyer. Geo. B. Foster, of the Bullock Electric Manufacturing Company, says they have more business than they can take care of, and similar reports are made by the representatives of other manufacturers. However, there is keen competition for most of the contracts of magnitude that appear in this market.

Quotations.

NEW YORK, Monday, December 9.

Pennsylvania Foundry Pig Irons, Jersey City delivery:

No. 1 X	$16 15 @ $16 65
No. 2 X	15 65 @ 16 15
No. 2 plain	15 15 @ 15 65
Gray forge	14 75 @ 15 00

Alabama Pig, New York delivery:

No. 1 foundry, or soft	15 75 @ 16 25
No. 2 foundry, or soft	15 25 @ 15 50
No. 3 foundry	14 75 @ 15 00
Foundry forge, or No. 4	14 25 @ 14 50

The minimum figures on Pennsylvania pig iron apply to futures rather than spot.

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.68c. in carload lots. From store, 1.90 @ 1.95c. in small lots.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—1.90 @ 2.00c. from store. There is a more or less prevalent disposition to name the upper figure as a minimum.

Cold Rolled Steel Shafting—Base sizes—From store, 2¼ @ 2½c.

Copper—Very unsettled. Lake ingot in carloads approximately 16¼ @ 16½c.; electrolytic, 15¾ @ 16¼c.; casting, 15¼ @ 16c.

Pig Tin—In 5- and 10-ton lots f. o. b., New York, 25¾ @ 26c.

Pig Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—4.32½ @ 4.37½c., New York delivery.

Antimony—Cookson's, 10¼ @ 10⅜c., and there is understood to have been some of it in the market as low as 10c.; Hallett's, 8¼ @ 8⅜c.; Italian, 7¾ @ 8c.

Lard Oil—Prime City, 79 @ 82c., in wholesale lots.

Some Notes on Travel in Brittany.

This town of Dinan, France, is one of the most curious old places I was ever in. It is an old fortified town, the fortifications being nearly continuous round the old town and still standing in places very perfect. One steep street, sloping about 1 in 3, forms the original entrance on the north side towards St. Malo. It is closed by a gateway called the Port Jersual fitted with the usual old contrivances for welcoming invaders with stones, melted lead and similar trifles. They don't meet us now with melted lead. We get through the fortifications freely and fight only with the hotel keepers, who, to do them justice, do not seriously pillage us. At one time Brittany was almost depopulated by wars. Then when the Saxons ravaged England the old Britons came over here in swarms and repopulated the land. Thus the Bretons are in a sense British, and a Welshman can get along with them in some parts better than a Frenchman.

Dinan stands on a rocky slope and plateau of granite at the side of the valley of the River Ronce. Across the valley is a fine granite viaduct nearly 150 feet high, of that fine proportion that distinguishes much of the civil engineering work of France, especially in structures of masonry. This forms a new and easier way to Dinan high above the old entrance to the Rue Jersual. Most of the streets are very narrow, the top floors of some houses nearly touching. The old hero of the place was one Dugueschin, whose chief trait was his unpleasant behavior towards the English, who were very uncivilly shut and kept out of Dinan about 500 years ago by his discourteous lead-pouring conduct. His statue stands on the old lists, but he would probably turn in his grave if he could return to see how the English swarm here and elsewhere in Brittany. Once built, a tower here will last forever. All is in granite, and though its surface crumbles the buildings seem imperishable, and the old castle is perfect and contains a perfect guide who explains things to visitors in clear and slow words.

In the Hotel de Ville is a museum, and here I found an old clock that was removed from the clock tower and is preserved here. I understood the old crone to say it was 400 years old, but I doubt this, because it has a pendulum. It is framed in bar iron fastened with pins like a wooden tenon joint. The pendulum carries a horizontal cross bar on a wheel. The pallets of the escapement are fastened and these engage the crown escapement wheel about a foot in diameter set on a vertical spindle and driven by lantern pinion. The striking gear is practically that of the cheap American clock of to-day, with a notch wheel about 30 inches diameter. There is a fan on a vertical spindle driven through a ratchet wheel, so that when the stop is let down the fan may continue to rotate without straining the gear, the ratchets slipping by the teeth of the ratchet wheel all exactly as in a big clock of to-day, but huge, bulky and crude in execution. The clock wheels seem to be of wrought iron, and I suppose the teeth are all carefully cut out of the solid. Anyhow, there was a lot of making in the clock, the frame of which measures about 5x4x3 feet, and does not differ greatly from that of the old clock of Rye in Sussex that is still at work. There is, however, in this French clock a key winder, the key shaft gearing by a lantern pinion on to a wheel on the barrel shaft to facilitate the work of raising the heavy weights.

The principal visible industry here is the making of "antique" furniture. Old samples are copied and the work is left out in the weather and acquires an old appearance. It is then sold to English and Americans. In the old days here the manner of proving yourself a gentleman was to put your mother's best saucepan on your head and strap the big dish cover in front of you. You then seized some handy scaffold pole and shouted defiance at the other side from the back of the first cab horse you could lay hands on. Some fellow similarly accoutred rode out from the other side, and the two of you rode at each other's pans or dish covers with the scaffold pole. The man who got the worst dint then went home to tea, and the victor paid for dinner for the girl they had quarrelled over. There always was a girl in the matter then, as now, but they were a trifle more picturesque in their surroundings in those days. Hence the place swarms with artists who sketch what they term "bits" with crowds of dirty little ruffians around them, and the inhabitants wonder why people come rooting out their back slums. But it differs from Fleet street or the Strand, and that, no doubt, is why we find it so interesting, apart from this having been the ground of so many hundred years of the fighting which seems to have been the all and end of history.

The curious thing is that with all these great walls and castles and towers, there appears no record of the building of them—none, that is, of the workers of those days. We read only of the fighters, who seem to have monopolized all attention. We read nothing of the smith who tempered the chisels that cut and smoothed this hard granite. But there must have been chisels, and of good steel, too. All the stones are cut accurately to form, and even the fine carved and molded work in the churches and the monuments are all cut and carved from granite; but the mason, the carpenter and the smith are unrecorded. The record remains only of the steel-plated, potted-head butchers.

The worst feature of France is the entire neglect of sanitation. Clothes are washed at the running river—if there is one. If not, they are "washed" in a pool of filthy, black, soapy water, which is never changed unless rain comes sufficient to do so. They are beaten with a paddle and hung to dry in sun and air—the only sanitary act in the drama. The net result is that "clean" linen reeks of filthy suds. Cottages standing naturally by streams are really alongside stagnant, hardly flowing pools of black, fermenting sewage. There is no water for domestic sanitary appliances—in fact, no ideas of what sanitary engineering consists of. After leaving Dinan we saw several of the insanitary places as above, and finally made for the sea, where we hoped for better things and a return to health shattered by sheer smell. We found a small town with neither good hotels nor sanitation.

Along the coast of Brittany there are numerous little islands, and we were tempted to cross to one in a small boat. We now call it "the blessed island," for we found here an old house with lovely gardens. One can see the blue sea all around, with innumerable jutting peaks of granite and an infinite variety of charm, and we share the discovery with so few that we agree not to name it, as we have no wish to find it filled up with average whisky-slogging holiday-makers. There is, moreover, some mechanical interest here. One of the many little inlets has a grassy rock half filling its seaward boundary. The gaps at either side have been filled by a wall. When the tide rises it pours over the wall and through sluices and fills the inner pool. At the end of the dam is a small square building, on which I see what appears to be an undershot Poncelet wheel turning. It is a tidal mill, the first I have ever seen. When the pure breezes of this blessed island have helped me back to health I will be able to walk the 300 yards to visit it and describe it better.

Now that I have seen the mill, I find it has a stout, octagonal timber axle with eight plank arms carrying a rim of square section about 7x6 inches. On the rim are fixed projecting boards, about 20x12 inches, somewhat Poncelet fashion, but more nearly radial. The whole is about 12 feet diameter at most, and it revolves its lower half in a narrow deep trough, into which water is admitted by a sluice from the dam above. At high tide the wheel is almost wholly covered. When the tide has fallen below the bottom of the wheel the sluice is opened and the mill works. Then the first 10 or 12 feet of ebb tide are lost, as regards time of working, but the total tide is 40 to 45 feet, and plenty of time remains over. There are any number of inlets that could be utilized for the same purpose. The tide here is tremendous. What at low tide appears a huge area of red rocks, jutting pinnacles and deep narrow channels of water, becomes brilliant blue sea with the pinnacles alone remaining. The tide runs in rapidly, racing around the rocky islets, swirling in eddies round the points and tumbling over the flatter rocks rather than running around them, and as it overruns more than it leaves uncovered, it is quite an

exercise in faith that it will not overwhelm "the blessed island" itself.

There are curious customs in Brittany. One of them is great respect for the dead, whom they will not bury far from home. Their churchyards are small, so that the occupant of a grave is a twelve years' tenant only. After this period the dead are dug up and placed in an ossuary, and, in one place we saw, they bury all the bones in a common pit and put the skull alone into a little labelled box, and a little skull house was full of these relics. The people are very devout, and apparently all are honest. We left our baggage by the shore below high-water mark. Someone would move it above tide level if we did not send to fetch it. Certainly no one would run away with it or leave it at the tide's mercy. We got along well with all the people, including the French officers, who behaved like ordinary mortals and were, so far as we have met them, excellent fellows. We left "the blessed island" with many regrets. W. H. Booth.

London, England.

Experiments on the Flexure of Beams — Discovery of New Laws—I.

BY ALBERT E. GUY.

INTRODUCTION.

The aim of the engineer is to build strongly and economically—in other words, to obtain a maximum effect with a given amount of material.

When the design of a machine is outlined, the various mechanisms being shown in place, the most important thing to do is to determine accurately the positions, directions and intensities of the forces applied to and developed by the machine. This done, the necessary sizes of the different parts are calculated according to the rules established by the science of the resistance of materials, and finally, feeling confident that his work will be strong enough within the limits just found, the designer judiciously modifies the shapes of the parts, in order to please his taste and to insure a neat appearance to the finished machine.

But when he began to materialize his conception he met a great difficulty: those rules apply only to well defined cases; and even then, notwithstanding scientific researches and numberless experiments, many of the formulas deduced therefrom and offered in our text books are difficult to apply, because of their indeterminate form. Often the designer has recourse to his experience, which undoubtedly serves him well when the case at hand has some similarity with those he has treated before, but which, at times, leaves him helpless before some unraveled combination of molecular forces. To loosen this new Gordian knot two instruments can be used—one, the mathematical analysis, and the other, carefully conducted experiments. The first of these is beyond the reach of the majority of engineers, but in order to be producive of successful results it must be corroborated by the second. To conduct experiments is a most delicate task, which before being undertaken requires much thought. Just as the analysis has a basis which is the study of the deformations of a molecule of matter caused by the various forces at play thereon, in the same way the objective basis of the experiments is the underlying principle, simple or complex, governing the case. The saying that every rule has its exceptions applies here; as with grammar, we must study first the one and then the others. The principle, once discovered, becomes a pole whence radiate an infinity of combinations. It is clear that, knowing their origin, the latter can readily be investigated. In practice the combinations are most generally met with, and the principle very rarely. This explains why many experimenters, mistaking the exception for the rule, have vainly tried to establish formulas generalizing the results of their investigations.

Therefore, since the science of the Resistance of Materials is primarily one of observation, it can be greatly furthered by the individual efforts of all those who have the rare opportunity to make careful and extensive tests. With this object in view, after many unsuccessful attempts to solve analytically a familiar question in flexure, yet convinced of the possibility of an exact solution and desirous of acquiring reliable experience, the writer undertook several series of experiments, the first of which is exposed in the following. He was thus fortunate in discovering some laws which had escaped investigation and which will be found of the greatest utility.

Posing as a problem the simplest case of flexure of a solid, a case of everyday occurrence to the designer, it will be shown, first, that the ordinary formulas are insufficient to solve it; then, the new laws being explained and applied, a complete solution will be obtained.

A SIMPLE PROBLEM.

It is required to design a beam having a minimum volume and which, firmly held at one end, must sustain at the other a load P acting perpendicularly to the length L.

To solve this problem it is necessary to know:

1—The kind of material composing the beam;

2—The modulus of elasticity of the material;

3—Its limits of elasticity;

4—The factors of safety, or ratios between the limits of elasticity and the longitudinal tension or compression which the fibres most remote from the neutral axis will be allowed to bear.

Any section distant a length x from the loaded end of the beam must resist a bending moment $P\,x$ and a shearing force P; but as the latter is not very considerable, compared with the former, it is customary, in practice, to neglect it in the calculations, and provide for it only at the point of application of the load.

Since the beam must sustain the load, the ultimate strength of the material is not a factor in the question, and the allowable stress per unit of area must be well within the limits of elasticity.

In accordance with the common theory of flexure the following assumptions are made:

1—The allowable tensile and compressive stresses of the material are equal and termed f;

2—The stresses in any section of the

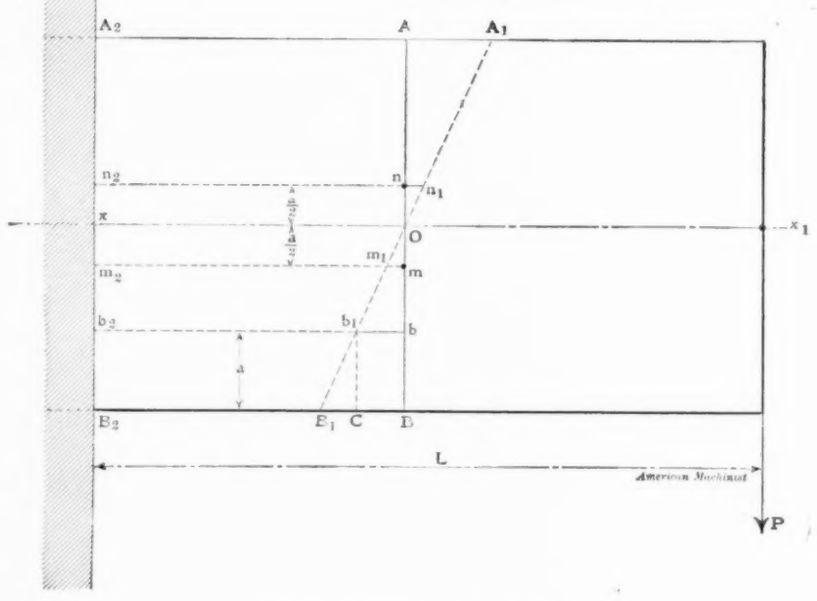


FIG. I. A BEAM IN FLEXURE.

beam are directly proportional to their distance from the neutral axis.

The equation expressing the relation between the exterior forces acting on the beam and the molecular forces developed by the former in a given section of the beam is:

$$Px = f\frac{I}{a} \qquad (1)$$

$\frac{I}{a}$ is termed the moment of resistance of a section having a moment of inertia I; and a is the distance from the neutral axis to the most strained fiber in the section.

When f is made constant in all the sections the beam is a solid of uniform resistance, and if each section has a minimum area the beam has a minimum volume.

Of the plain sections, the most employed are the circular, the square and the rectangular. If the first or second is chosen the problem is partially solved, because the expression of the moment of resistance contains then only one unknown quantity which can easily be found by assigning to x a numerical value. But the rectangular form is very much more economical than the other two, since, in varying one of its dimensions, the area can become very small and at the limit be zero. Effectively, for a rectangle the moments of inertia and of resistance are respectively:

$$I = \frac{b\,h^3}{12} \qquad \frac{I}{a} = \frac{b\,h^2}{6},$$

in which expressions b is the base and h, parallel to the direction of the load, is the hight of the section.

Replacing in equation (1) $\frac{I}{a}$ by its value as above we have:

$$Px = f\frac{b\,h^2}{6}$$

For a chosen value of x,

$$b\,h^2 = \frac{6\,Px}{f} \qquad (2)$$

and it remains to find the ratio of b to h which will make the area $A = b\,h$ a minimum.

The expression (2) is indeterminate since the factors b and h are both unknown. In practice a value is assumed for one, and the other is thereby determined; but knowing that the greater the side h the smaller is the area, the designer is much embarrassed, for, if the ratio $\frac{h}{b}$ is small, the area of the section is considerable, and if the ratio is large the beam may be so thin that it will warp laterally and be thus unable to sustain the load.

At this point a search for help through the text-books results in bringing out for consideration: (1) The transverse shearing, which we have neglected at first; (2) The longitudinal shearing; (3) The deflection of the beam.

THE TRANSVERSE SHEARING.

In this case any section must be large enough to resist the shearing force P; hence, if f_s is the allowable shearing stress, we must have:

$$\frac{P}{f_s} = b\,h \qquad (3)$$

This equation insures strength enough at the loaded end of the beam, but evidently does not provide against lateral warping. Should this area (3) be adopted equations (2) and (3) combined give:

$$b\,h = \frac{6\,Px}{fh} = \frac{P}{f_s}$$

$$\text{and } h = \frac{6f_s}{f}\,x$$

Generally,

$$f_s = \frac{4}{5}f, \text{ whence } h = \frac{6\times 4}{5}x = 4.8\,x.$$

We have thus the ridiculous result that the hight of the section at the danger point must be nearly five times greater than the leverage of the bending force. It is evident that equation (3) cannot help in solving the problem. However, it must be admitted that the method followed here, although employed by some authorities, is not very correct, for, really, the expressions (2) and (3) instead of being equated should be combined.

THE LONGITUDINAL SHEARING.

The longitudinal shearing force is that which tends to destroy the adhesion of the laminæ of which the beam is assumed to be formed.

Mr. Jouravski was the first who took into consideration a longitudinal shearing force, maximum in the neutral plane of the beam. (See "Annales des Ponts et Chaussées, 1856).

Professor Reuleaux treats this subject in his "Constructor" as follows: "Since in a deflected beam there is on the tension side a continual tension, on the compression side a continual compression of the fibers, it follows that the neutral plane is subjected to a shearing action and this must not be neglected in determining the width of the beam. The lowest limit permissible is indeed a matter not likely to be reached, but the same time it should be investigated. . . ."

This does not agree well with the previous paragraph, No. 6, in which the same author says: ". . . The neutral axis may be considered as a sort of equator of each section, since it passes through its center of gravity at right angle to the plane in which the bending takes place. It thus divides the sections into two portions, in one of which all the fibers which are parallel to the axis of the prism are subjected to a tension proportional to their distance from the neutral axis [the tension side of the section], while in the other portion the corresponding fibers are subjected to compression in a like proportion [the compression side of the section]. *It follows that fibers which are at equal distances from the neutral axis will be deformed to the same extent.* . . ."

Let us now consider the beam represented in Fig. 1. The neutral axis $x\,x_1$ passes through the center of gravity O of a section at $A\,B$. The bending force P acts perpendicularly to the length L. The part $A\,O$ is in tension and $O\,B$ in compression. After the load was applied the points A and B occupied the positions A_1 and B_1 respectively. [The distances $A\,A_1$ and $B\,B_1$ are of course greatly exaggerated in the figure, for the sake of demonstration.] A portion $b\,b_1$ of a layer of fibers situated at a distance a from B represents the amount by which the compression shortened the layer $b\,b_2$ proportionally to its distance from the neutral axis. The displacement of point B is $B_1c + Bc$ [line b_1c being parallel to $A\,B$]. Then B_1c represents the amount of sliding of the layer $B\,B_2$ over its neighbor $b\,b_2$. Two other points n and m such that $n\,o = m\,o = \frac{a}{2}$ occupy now the positions n_1 and m_1 respectively. The lines $n\,n_1$ and $m\,m_1$ are parallel, and the former represents the extension of the layer $n\,n_2$, or the amount of sliding of that layer over the neutral plane, which is assumed to be invariable, while the other is the amount of sliding of the compressed layer $m\,m_2$ over the same plane. Consequently the relative sliding of one layer over the other is $n\,n_1 + m\,m_1$. But angle $A\,O\,A_1 = B\,O\,B_1$ since tensions and compressions are proportional to their distances from the neutral axis, hence $n\,n_1 = m\,m_1$ and $n\,n_1 + m\,m_1 = B_1c$. In other words, the longitudinal sliding or shearing and consequently the resistance to it are the same for all the layers of fibers, independently of their distances from the neutral axis, and are proportional to the leverage of the bending force P.

Mr. Jouravski remarked that if two equal rectangular prisms of length L, horizontal and fixed at the same end, are simply superposed, they will support together at their free end a weight P, which is only one-half of that which they could carry if prevented from sliding over one another, or had been cast together. This is expressed by the following equations:

For a solid prism, $P_1 = f\frac{b}{6\,L}\cdot h^2$

For two superposed prisms, $P = f\frac{b}{6\,L}\cdot 2\left(\frac{h}{2}\right)^2$

b is the width common to these beams, h is the sum of hights of the small beams and the hight of the solid prism.

Hence $P_1 = 2\,P$.

Instead of two beams having a total hight $= h$, suppose we have a number n of them, the hight of each prism will be $\frac{h}{n}$ and the load supported by the sum of the superposed beams will be:

$$P_n = f\frac{b}{6\,L}\cdot n\left(\frac{h}{n}\right)^2$$

Consequently $P_1 = n\,P_n$.

It is thus shown that the resistance to longitudinal shearing of the layers of fibers is proportional to the number of these layers, but not to their respective positions, as Mr. Jouravski stated.

We may also remark that, if the superposed prisms were fixed at both ends, the sliding would not take place as in the case just analyzed, and the system would behave as a solid of the same total rectangular section.

In the foregoing we have assumed that the bending was not great enough to cause the rupture of the beam, consequently it is quite admissible to conceive any transverse section, *plane*, as well before as during the application of the load. But when permanent deformation preceding rupture is likely to occur, the sections do not remain plane, and equation (1) is then insufficient to express the relation between the exterior and the molecular forces. Mr. de Saint Venant in his memoir on flexure (1856) has conclusively proven that the shearing stresses, transversal and longitudinal, combine, in such a case, with the tensive and compressive stresses, the result being that any section originally plane becomes distorted in the form of a double curve, each half of which is a parabola of the third degree.

The safe resistance to the longitudinal shearing is:

$$f_l = \frac{3}{2}\frac{P}{b\,h} \qquad (4)$$

as given by Jouravski, Bélanger, Bresse, Reuleaux, etc.

Professor Reuleaux makes $f_l = \frac{4}{5} f$. If equations (1) and (4) are combined and this value of f_l is introduced therein, we have:

$$\frac{5}{4} \times \frac{3}{2}\frac{P}{b\,h} = f = \frac{6\,P\,x}{b\,h^2}$$

whence $h = \frac{16}{5}\,x = 3.2\,x$, quite a useless value for our problem.

Mr. L. Vigreux ["Résistance des Matériaux] says: "If the material composing the beam is close-grained $f_l = f$; but if of a fibrous texture, like wood, the value of f_l is different from f. No experiments have been made in order to determine the value of f_l, and for the present *we must solve the equations by choosing for* $\frac{h}{b}$ *the value adopted in practice.* . . ."

Therefrom we conclude that in practice the ordinary longitudinal shearing cannot be employed as a factor in the calculations, and that it may become dangerous only because of the bad choice of the point of application of the load, or on account of the defective manner in which the beam is fixed.

As to the Metacenter.

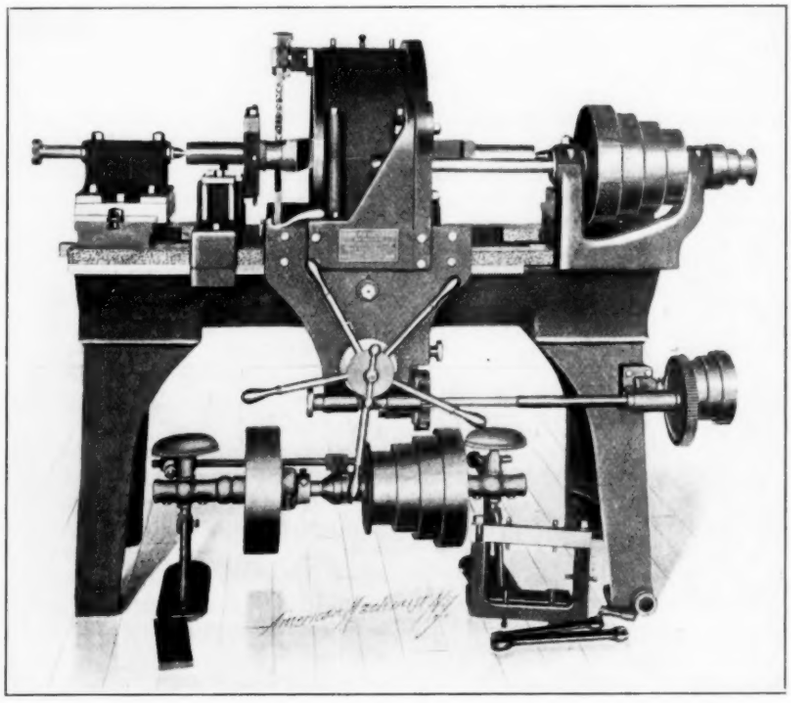
Emperor William of Germany attended a meeting of naval engineers a few days ago and told a good story as follows:

"Some fifteen or twenty years ago my interest in and my zeal for naval questions led me to approach an old naval officer and request of him an explanation of the metacenter of a vessel. He answered that he himself did not exactly know what this was, and besides, it was a secret. He could only tell me that if the metacenter was in the maintruck, the vessel would capsize."

A Crank-Pin Turning Machine.

The machine here shown is for turning crank pins on solid shafts, also for eccentrics when they are cast or forged on the shaft. By the use of this machine the usual tedious process of turning such crank pins on the lathe is avoided. In this machine the pin to be turned is stationary and the tool travels around it. The center of the pin is placed in the center line of the machine, and the shaft is at the side. If the shaft is short enough it is placed on centers, but if longer the turned part is set in V's, or round bearings, which hold it parallel and firm. These holders for the shaft are alike on each end of the machine. They are movable lengthwise of the bed and are each clamped by two bolts like the ordinary tailstock. Cross-slides, independently clamped, provide for the adjustment of the centers or the V bearings, according to the throw of the crank. Inside these shaft holders is another bridge-bar, as it is called, clamped upon the ways of the machine for holding the crank, or especially the crank-pin end of it securely in position. A piece is provided which goes loosely over one of the sides of the crank with a wing or foot which is fastened to the bridge-bar, and then set-screws around the crank are adjusted and tightened and the crank pin is held securely against the cutting strains.

When the pin is thus set it remains stationary until the turning is completed, all the necessary movements being given to the cutting tool. A carriage is provided with feed motions for the longitudinal movement similar to those of the ordinary engine lathe, as shown in the half-tone, Fig. 1, and which it is unnecessary to describe. In the drawings, Fig. 2 differing in this respect from Fig. 1, the feed movement is derived from an eccentric groove in the face of the gear end of the large ring. In this groove a pin on the end of a lever works, and the motion is transmitted by lever and pawl to the feed train. On the other end of the rotating ring, and overhanging it somewhat, is a cross slide which carries the cutting tool. This slide is operated by a screw and star feed. The feed now used is as shown in Fig. 1, Fig. 2 being introduced to give a better idea of the general construction. There is a sufficient movement of the slide for facing the collars at the ends of the pin, as well as for adjusting the tool for cutting the cylindrical portion of the pin. The head of the screw is graduated and also the tool slide for minute and accurate adjustments. Fig. 3 shows a portion of the cross slide with the tool in position. The machine is made to be driven by belt, as here shown, or with an electric motor mounted on the machine. The inventor is Charles Vogel, Fort Lee, N. J., and the machines are built by the Crank Pin Machine Company, 135 Broadway, New York.

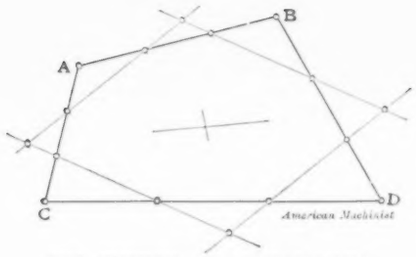


A CRANK-PIN TURNING MACHINE.

Centroid of a Quadrangle.

The neat and simple construction here shown is from a contributor's note to "Science":

To find the centroid of any quadrangle *A, B, C, D*, divide each side into three



THE CENTROID OF A QUADRANGLE.

equal parts, and draw lines through adjacent points of division, as indicated in the figure. It is easy to prove that the new figure is a parallelogram, the center of inertia of which coincides with the center of inertia of the original quadrangle, both occurring at the intersection of the diagonals of the parallelogram. The areas of the two figures differ.

Echoes from the Oil Country.

FITTING UP ECCENTRICS.

Some shops have ways of doing things which seem to work well with them, but would be thought very poor practice in other places. Where engines are made for rough, hard work, without finish and as cheaply as possible, probably the ways of doing the eccentrics are as varied as any other part, and are as likely to give trouble as any part. Whoever went to fix up an old engine that didn't take at least a look at the eccentric straps, and see if they needed filing or a liner taken out? and how anxiously they are felt of and watched to see if they are heating when the engine is being run for the first time.

Well, I saw a way of doing eccentrics in one place that gave good results and was cheaply and quickly done, but I never saw it in any other shop. Their engines were made with a link, and the eccentric body was cast in one piece for the two eccentrics. The straps had flanges or lips that fitted down over the eccentric bodies. These lips instead of being square were cut at an angle. Each strap was cast in two pieces, one piece carrying a good-sized cavity for an oil cellar, while the other one had a projection that the eccentric rod fitted into.

The ears were first planed and drilled, and one side was tapped for the bolts. They were then bolted together without liners and bored to a gage, a lot being done at once. The hubs were turned a little *larger* than the straps were bored. When a hub was turned a strap would be taken apart, and one-half would be held against it until it would go partly on when the other half was held on for a little in the same way. Then the bolts were put in, and with a bar in the eccentric rod slot the bolts were screwed down, while the dust flew and the lathe howled, and the new man wondered what kind of farmers he had got among to not know better than that. He only wanted a chance to see the job after it was done. He soon got a chance and found a very good job, and that a man was turning a hub and fitting on two eccentric straps in an hour each and keeping it up, and that they had the best bearing he had ever seen on eccentric straps. In use they gave no trouble and did not need any care except oil.

Before trying this plan there are a few simple points to know and *mind* if you want to succeed, and one thing above all others. Keep your oil can locked up while fitting the straps; this *must* be done dry. Do not even brush your hand across either the hub or straps after the tool leaves them. Continue the grinding until the bolts pull the strap hard together and then let the lathe run a little, the dust will grind enough large to give room for oil. If the process is not carried far enough a piece of paper may have to be put in to give clearance.

I once told this operation to a friend in a job shop, and he tried it and thought me a fraud. He got a job that made him feel like thrashing me. It was a horrible affair. I told him it was the oil he used. "I suppose you think I am fool enough to believe anything since I was fool enough to try that," he snorted, "but I never put oil on to make anything go to cutting yet. There wouldn't have been anything left of the blamed thing if I hadn't put the oil on, and there isn't much left as it is."

You know it's not much use to talk sometimes, and I had to grind in one myself to convince him, and then push him away with his oil can when things began to get noisy. That one didn't cut. You understand this is done dry, without anything being put on and just uses its own dust for grinding material. I saw dozens done before I ever tried it, and was used to the noise and dust, but I would advise a new beginner to lock up his oil can and put they key in his pants pocket inside his overalls, where it is hard to get at in a hurry. If he will only let the lathe run while he is trying to fish out the key he may see it is not needed before doing harm with it. If too much is allowed to grind out, the dust will need to be shaken out before getting quite down.

Just in this connection one curious thing impressed me. While this shop made a great many engines for oil-well drilling and fitted up the eccentrics in this way, getting excellent service, when they built what they called stationary engines they went back to the old way, trying to scrape to a bearing and using liners. My experience with these was that they were not nearly so good a job, as you could seldom find one that had a good bearing, even after considerable running, and the adjustment on the liners was seldom just

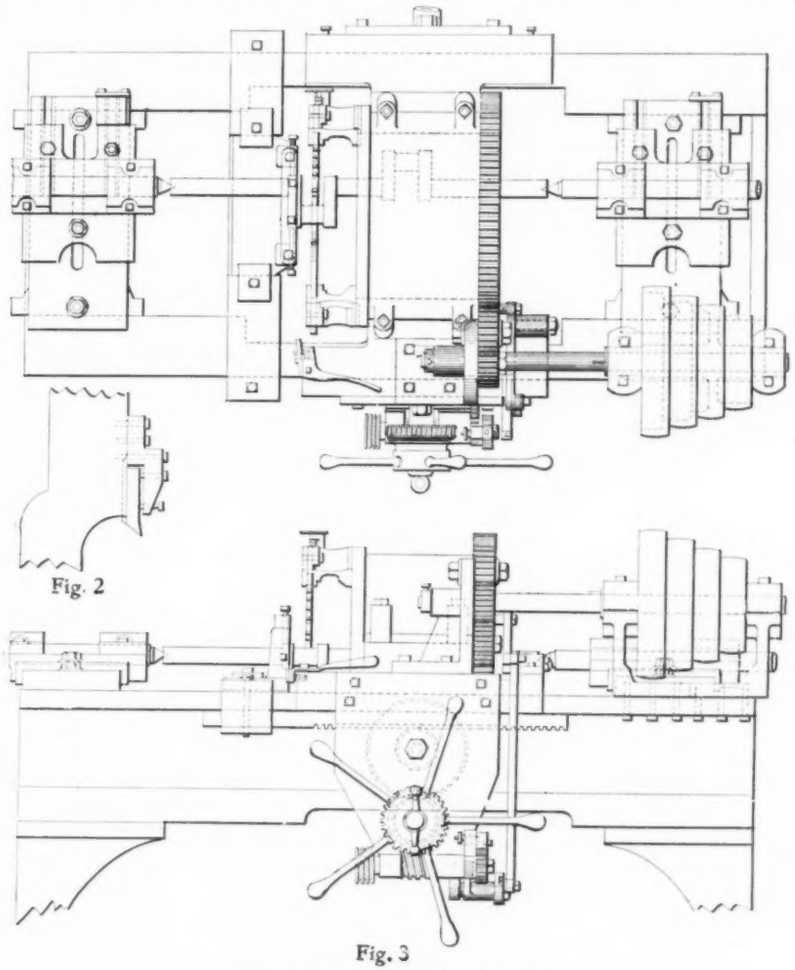


Fig. 3

A CRANK-PIN TURNING MACHINE.

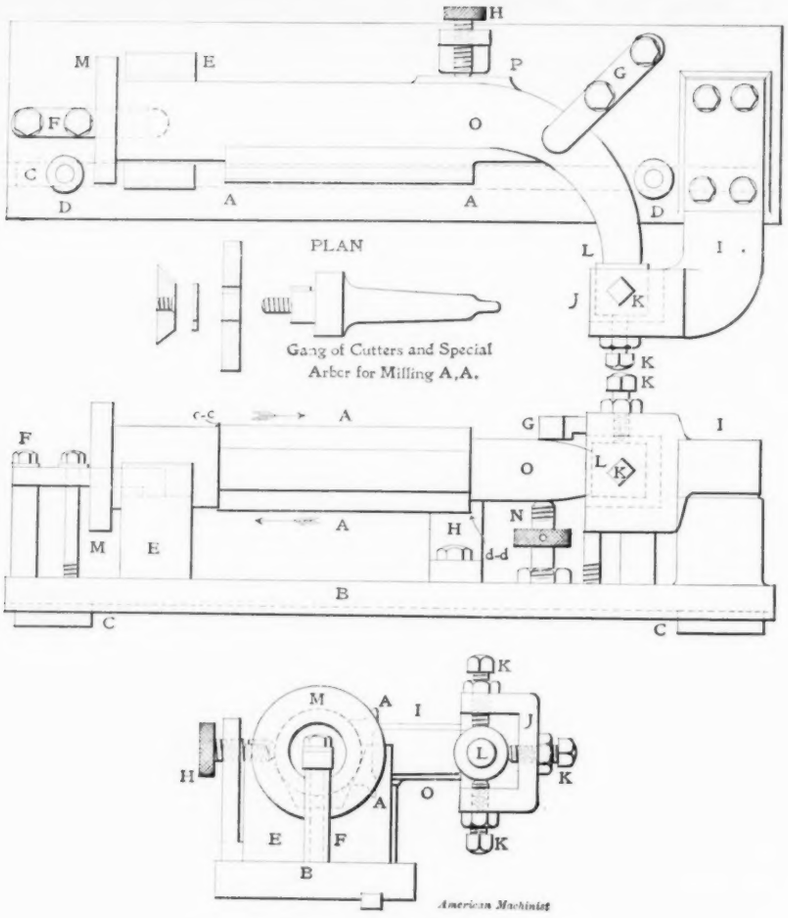


FIG. 1. FIXTURE FOR MILLING THE SLIDE.

right. I was never sure why they made the difference in their practice, whether to suit the prejudice of the users or for some other reason. Where this way originated I cannot say, but I never saw it anywhere else. W. OSBORNE.

Machining Drill Columns.

BY WILLIAM DORAN.

The tools here shown were for machining the upper columns of small, one-spindle drill presses. The column is shown in position on the fixtures. The points machined are: the finishing of the slide surface *A A* for the adjustable spindle head by milling, as shown in Fig. 1; the face milling of the base *M* and of the back *P*, as shown in Fig. 2, and, lastly, the boring of the hole for the spindle through the column at *L* and through the spindle head *Q*, as shown in Fig. 3.

The milling of the slide surface is done first in order to have a reliable surface by which to locate for the following operations. The body of the fixture is a long casting *B*, with a high projection at each end, the one at *E* being a "V" for the body of the column, and the one at the other end flat and square with the base, for the head-supporting bracket *I*. This bracket is of cast iron, cored out at *J*, so that the head of the column *L* will enter it, the inner side of *J* being open so as to allow of this. The bracket is fastened to the body casting by four cap screws. A feather *C* is let into each end in a channel in the base, to locate it in the slot of the miller table, and it is fastened by bolts through the holes at *D D*. Two clamps at *F* and *G* are used to fasten the work, *F* being nearly over the vertical adjusting screw *N*. A nurled head screw at *H* forces the head *L* against the locating set-screw *K*, in the face of the bracket *I*, and the two other set-screws *K* act vertically as locating and fastening screws.

For the milling, a gang of cutters and a special arbor of the shape shown are used, the angle or first cutter being threaded with a left-hand thread to screw on to the arbor and force the other two cutters tightly together. The narrow cutter is to finish a flat along the extreme edge of the milled surface, and the large one is for milling the face. The last two cutters are keyed to the arbor.

The fixture is first bolted to the miller table, and the work is fastened upon it, adjusting all locating screws so that approximately the same amount of stock can be removed from all parts. As the variation in the castings is very little, if the first column has been machined correctly all the others will be. A gage is used to set the gang of mills. The work is moved up to the cutters until the facing cutter is

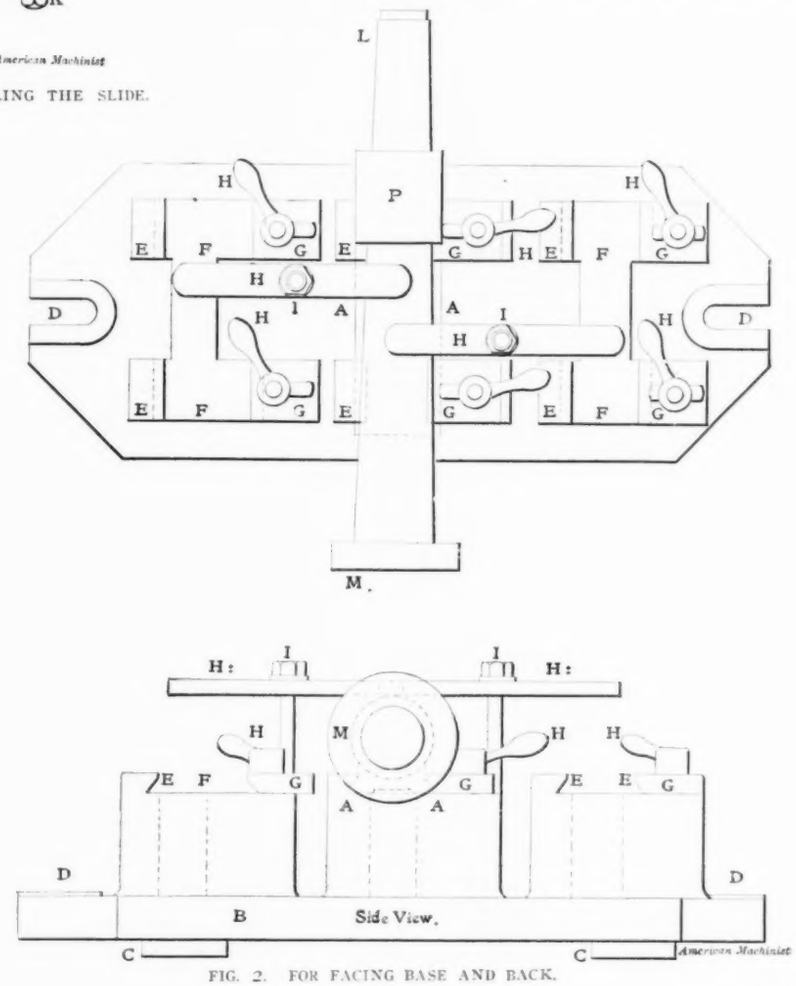


FIG. 2. FOR FACING BASE AND BACK.

removing the required amount of stock and the angle cutter is touching the gage. When the top is finished, the table is raised and the under side is finished, starting at *D D*. Before this fixture was designed, the finishing of the slide *A A* was done on the planer, but by this arrangement the same results were accomplished in one-third the time, and to a far greater degree of uniformity.

For facing the base *M* and the surface *P* the fixture shown in Fig. 2 was used. This was made for three columns, only one of which is shown. The dovetailed slide surface previously machined is utilized for locating and fastening the columns. The fixture consists of one heavy body casting, with three standards on which the work is fastened. The locating surfaces, at *F F F* respectively, are finished on the planer, one side at *E* with a dovetail of the same angle as that of the machined surface. Two angular-faced clamps *G G*, with clamp screws *H*, are used for fastening each column. Two straps *H H* also are used, although they are not absolutely necessary.

The bases M are finished first, doing the entire number of castings. They are then reversed on the fixture and the backs *P* are faced with an inserted tooth face milling cutter, which is fastened in the vertical attachment. The same cutter is used for facing the bases of the columns.

The boring fixture is shown in Fig. 3, in the side view of which the work is shown in position, with the spindle head attached to the slide surface, ready to be bored. The boring and finishing of the spindle hole in the head *L* of the column and in the spindle head at one and the same time is necessary in order to insure the alinement of those holes. This fixture is rather more intricate and expensive than the two preceding, but the cost was approved by the result.

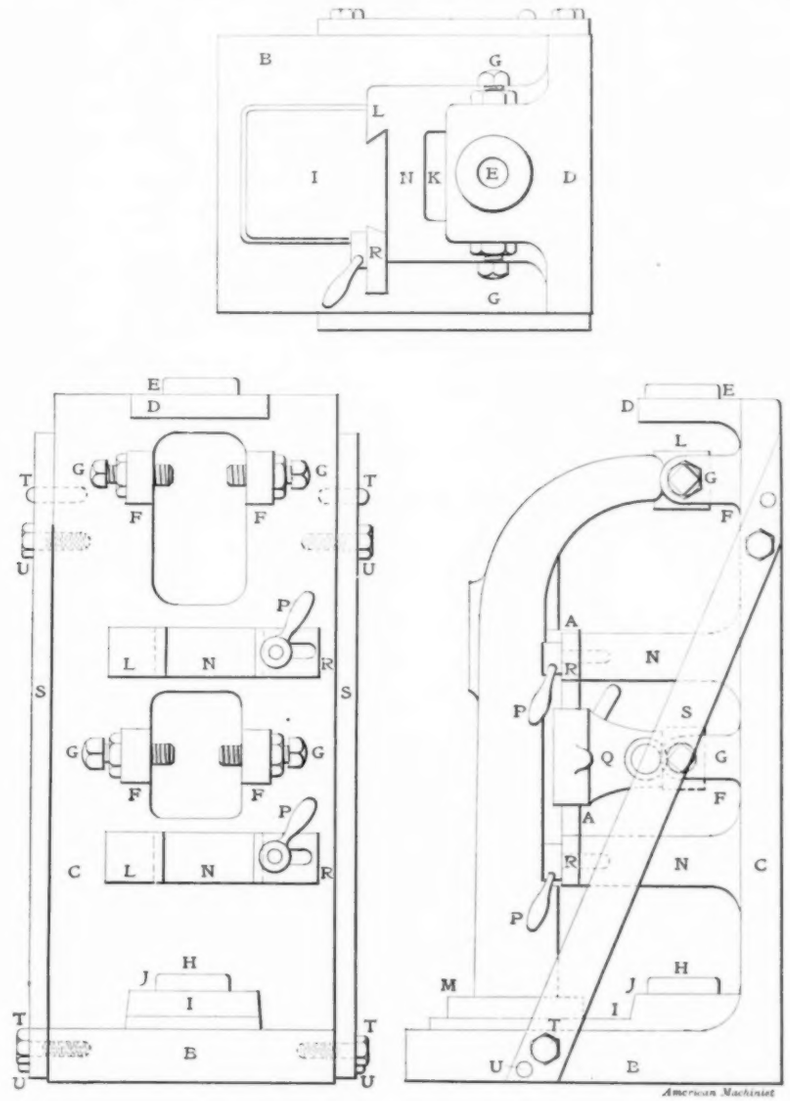


FIG. 3. JIG FOR BORING COLUMNS.

The fixture is in the form of a tall angle-plate, with two standards *N* projecting from the inside of *C*, for the locating and fastening points. These standards are cored at *K*, as shown in the end view, to clear the boring bar. Bevel faced clamps *R R*, with clamp-screws *P P*, secure the work. There were two bushings, one at the top in *D* at *E*, and the other in the base *J* at *H*. The holes for these bushings were cored small in the fixture when cast, and were bored to finish size on the large drill press on which the fixture was to be used. Before boring and finishing these holes the other locating and alining points on the fixture were finished, and the piece was strengthened by fastening two wide and stiff machine-steel straps at the sides as shown at *S S*. These straps strengthened the fixture considerably and insured its rigidity.

The bushings *E* and *H* were of tool steel, hardened and lapped to a good fit on the boring bar, and then ground on the outside and forced into their respective holes. There were four lugs *F* with hardened set-screws *G* and check nuts to resist side thrust when boring the holes in *L* and *Q*. Large openings in the upright at *b b* and *c c* are convenient for inserting, fastening and removing the cutters from the boring bar.

The fixture rests on the base *B*, on the table of the large drill press, and the work is fastened as shown. The boring bar is then slipped down through the bushings, and the table of the drill press is swung around until the shank of the bar can be driven up into the drill spindle. The roughing cutters are fastened in the bar and fed down through the holes. The bar is then raised, the roughing cutters are removed, a finishing set is substituted, and the holes then finished.

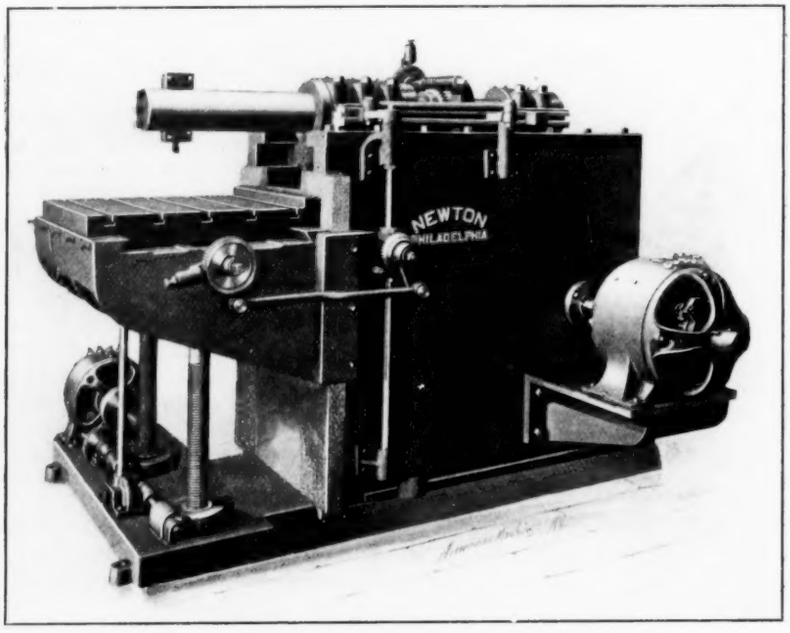
The boring fixture here shown is used only for machining single-spindle columns, as for the two, three, four, five and six-spindle frames a special self-driven machine, that may be set to bore two columns at once, is used. In this machine the work is located and fastened upon it in the same way as here shown, the difference being in the driving of the boring bars or cutter spindles by bevel gears, and feeding them through the holes in the work by a pinion and rack, in relatively the same manner as on a self-feeding drill press.

An Extra Heavy Shaping Machine.

We illustrate herewith a shaping machine of unexampled size and weight which has just been completed by the Newton Machine Tool Works, of Philadelphia. It is intended more especially for cutting off risers or gates from steel castings. It has, however, a rotary feed of the cutter bar by which it is adapted for shaping out the inner ends of the field pieces of electric motors. This feed is accomplished by turning the cutter bar bodily in the ram head through the worm, ratchet and swinging pawl lever at the center of the cutter bar. This feed is automatic through the action on the pawl lever of the dogs at the ends of the ram guide.

The drive will be seen to be electric by an attached motor and to secure sufficient reduction of speed for such heavy work.

as is to be done two quick pitch worm gears arranged in succession are used. This looks like a bold confidence in worm gearing, but it is, we believe, fully justified by the experience of the Newton works with steep pitch worms. The drive of the ram head is by a crank and Whitworth quick return motion, the Whitworth motion being shown on the face of the larger worm gear. The crank is inside the frame and connects with a block on the under side of the ram head. This block is adjustable in the undercut V-grooves on the ram head, and by this means the reach of the bar is adjusted.



AN EXTRA HEAVY SHAPING MACHINE.

An automatic feed of the work table is provided, as well as power elevation of the knee, through an independent motor. A fine adjustment by hand is also provided through the squared shaft end on which the workman's hand rests in one of the views.

The extreme length of stroke of the ram head is 18 inches. The cutter bar is 9 inches in diameter and the gross weight is in the neighborhood of 30,000 pounds. The unusual hight is to provide rigidity and to give sufficient range of adjustment of the knee. When set for use about one-half the hight will be below the floor line.

American Locomotives in France.

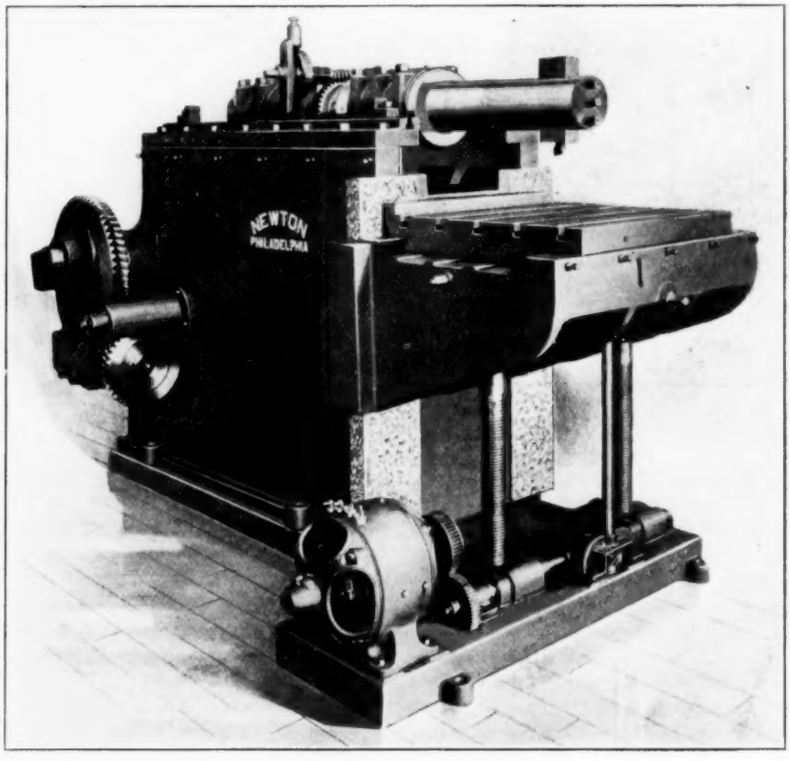
United States Consul Robert P. Skinner sends from Marseilles the following information concerning American locomotives on the Paris, Lyons & Mediterranean Railway:

"The first delivery was made in this city in March, since which time the locomotives have been in process of erection in the company's shops at Arles. I have been informed by one of the officers of the company that after these machines had been erected, the controlling forces of the roadmaster's department objected to their use, because of the fact that the weight was unevenly distributed over the various sets of wheels. It was thereupon concluded to make such changes in the mechanism as would evenly distribute the weight to the satisfaction of the roadmasters. This has now been done, and the machines are in partial commission. While they are thus, indeed, American locomotives, it does not appear that they are absolutely of the type commonly manufactured in the United States. My informant tells me that in preliminary runs, these locomotives maintained a speed of 71.45 miles per hour.

"A local newspaper of to-day supplies these additional details: 'Yesterday morning for the first time the rapid express, No. 7, was conveyed from Avignon to Marseilles by one of the new American locomotives erected at Arles. This machine, No. 2999, was attached to a train of four large cars of the first class, weighing 34 tons, and two baggage cars, the total weight being 181 tons. The mining engineers charged with the control of this matter have been making recently, in connection with other principal agents of the company, numerous experiments with these machines between Miramas and Arles. The rates of speed attained have exceeded at certain moments 77.67 and 80.77 miles per hour upon this portion of the track, which, by reason of its favorable condition, lends itself better than any other to these interesting and important experiments, the results of which, from the point of view of regularity of speed and general stability of these new engines, have been most satisfactory.'"

The Speed and Accuracy of the Slide Rule.

We note in the "Practical Engineer" some records of tests of the slide rule by Louis Deer, which were undertaken with a view of determining its average percentage of error. It is commonly considered that the ordinary 10-inch rule is accurate



AN EXTRA HEAVY SHAPING MACHINE.

to about one-half of one per cent. These tests, of which 136 are covered by the table of results given in the article, show that the percentage of error is materially less than this. The author points out that for many uses the superior accuracy of the lower scales is usually overestimated. These cases are the frequent ones in which the lower scales require more settings and readings than the upper ones, the errors due to these additional settings and readings more than offsetting the gain due to the increased openness of the scales. The tests included both simple multiplication and other operations in which several settings and readings were involved. Some comparisons were also made of the speed of the rule and of calculating machines. These the author admits are not entirely satisfactory, but he concludes that:

"Broadly speaking, the writer has observed that a computation carried out to a given number of places by rule will require half again as much time by machine. To get an additional place of figures by machine, twice as much time must be taken as in the first case by rule. This result, though not necessarily valid for all observers, testifies at any rate to the extreme rapidity of slide-rule computation, since it is a well-established fact that on four or five figure work machine computation requires from 35 to 50 per cent. of the time required with logarithms."

The following are his conclusions regarding the accuracy of slide-rule work:

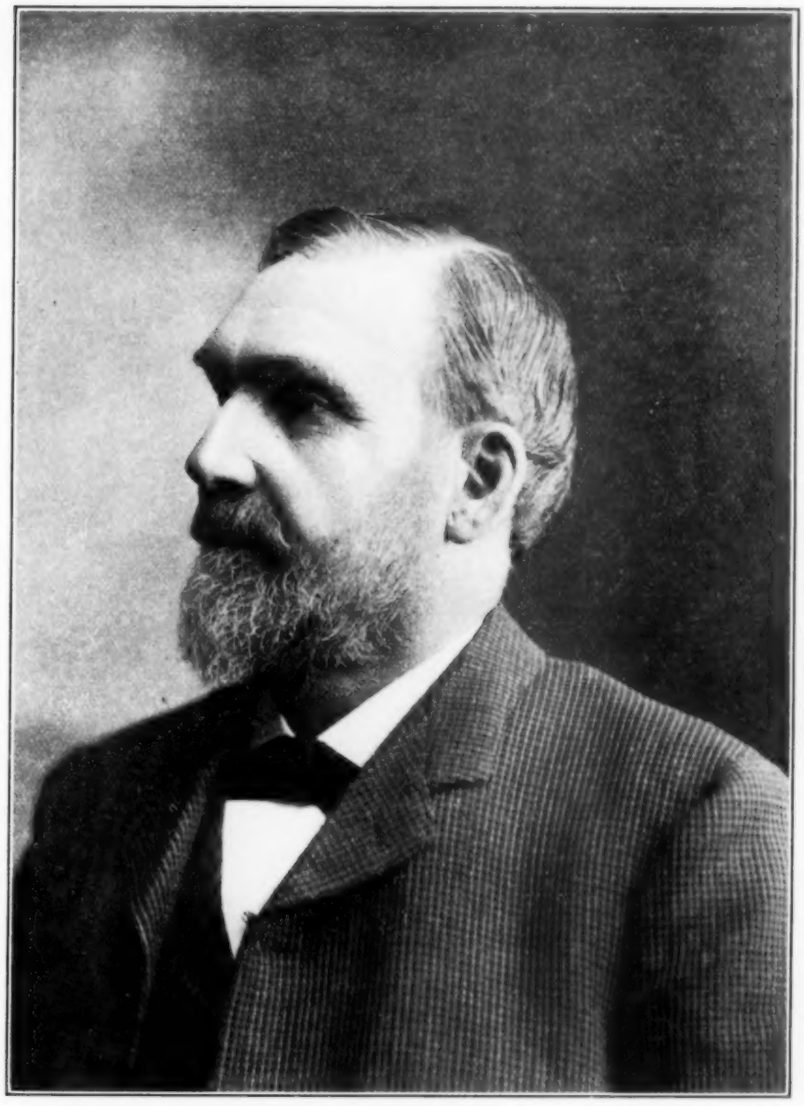
"For short calculations the upper scale of the 10-inch rule is reliable to one-quarter of one per cent. The lower scale is better than one-fifth of one per cent., and may generally be used instead of a four-place logarithm table. It should be observed that the upper scale of the 20-inch rule and the lower scale of the 10-inch rule are graduated alike.

"For short calculations the lower scale of the 20-inch rule is reliable to one-tenth of one per cent., and may be used instead of a five-place logarithm table.

"If five places of figures are to be obtained and the intermediate products are required, the 20-inch rule is not much faster than a machine, and is vastly more fatiguing.

"In applying the above conclusions to practice two things must be prescribed: The rule employed must be accurate, and the computer should be practiced in the estimation of tenths. Other than this, no unusual skill is required, nor is any claimed in the above tests."

It is reported that fifteen foremen of the Edgar Thompson Steel Works, in Braddock, Pa., have been taken into partnership with the Carnegie Company, $150,000 worth of stock being distributed among them. Heretofore it was only the heads of departments who received bonuses like this.



EDWIN REYNOLDS, NEWLY ELECTED PRESIDENT OF THE A. S. M. E.

Edwin Reynolds, President of the American Society of Mechanical Engineers.

The engineering world cannot fail to appreciate the eminent fitness of the selection of Mr. Edwin Reynolds as president of the American Society of Mechanical Engineers. We take pleasure in presenting here a portrait of Mr. Reynolds, with some interesting particulars of his career.

Mr. Reynolds was born in 1831, at Mansfield, a little town in northeastern Connecticut whose present inhabitants number less than 2,000. There was a large family, six boys and six girls, and Edwin was next to the youngest. He was a farmer's boy. His father had been a cloth dresser, and he had on his place a fulling mill run by water power, but this had not been in operation within the boy's recollection. His father was running the farm and Edwin worked on it and went to the district school, his last schooling being in his sixteenth year, and then a change came in his life. He had up to this time little or no knowledge of the machine shop, and nothing had turned his thoughts or inclinations in that direction. At the age of sixteen Mr. Reynolds started out as a farmhand, engaging first with a neighbor for six months at $11 per month. He had worked only about a month when one day as he was busy in the middle of a field a man climbed over the fence and came to him. The man asked first if he was one of the Reynolds boys, and then whether he would like to learn the machinist trade. It was a new idea to him, and he had to think over it for a little while before he said that he would, but he immediately added that it would not be possible to begin just then as he was engaged to this farmer for six months. The farmer was a reasonable man. On being consulted he said: "Would you like to learn the trade, Ed?" "I think I would," said Mr. Reynolds. "Well, a trade is a mighty good thing to fall back on. I'll tell you what I'll do. You come and help me for a month in July and I'll let you off now." So a three years'

apprenticeship was begun with Anson P. Kinney, who had a general machine shop, with a specialty of sewing-silk machinery; several cards, or carding machines, also being built during Mr. Reynolds' apprenticeship. A country shop in 1847, we can well understand, was a crude affair. There was in the first place no foundry. The tools of the shop comprised one 20-inch engine lathe, one bench lathe, or, as we might now call it, a patternmaker's lathe, one vise and a circular saw. Some creditable machines were, however, turned out, and Mr. Reynolds' apprenticeship consisted largely in learning, not the trade as we understand it, but "how to do things without any appliances wherewith to do them." A memorable event of Mr. Reynolds' apprenticeship was the addition of a 16-inch lathe to the plant. Mr. Reynolds lived with his employer and their relations were more like father and son. His wages were: for the first year $30 and his board, the next year $45, and for the last year $60.

On the completion of his apprenticeship Mr. Reynolds worked as a journeyman for a year with Smith, Winchester & Co., at South Windham, Conn., who built paper machinery, and then he went as a journeyman to the Woodruff & Beach Iron Works at Hartford, one of the large companies of that time, who built slide-valve steam engines and general machinery. While Mr. Reynolds was working there Mr. Wright became engineer of the works, and they began the building of the Wright engine. No concern in those days, however, built engines exclusively, and Woodruff & Beach among other things turned out a lot of stone-dressing machinery, in the building of which Mr. Reynolds soon became a gang boss, eventually taking charge of all that line of work both in the shop and in the erection of the machines after they were sent out. This connection continued for six or seven years, or until 1858, when Mr. Stedman, of Stedman & Co., Aurora, Ind., who had been a classmate of Woodruff, came East looking for a superintendent, and Mr. Woodruff—as some other employers have nobly done, but as some would not have done—recommended his subordinate as precisely the man for the position, and so Mr. Reynolds went to Aurora as general superintendent. The silent partner of Stedman & Co. was a resident of Aurora—J. W. Gaff, a wealthy distiller and steamboat owner—and, with Gray and Gordon, the owner also of the Niles Tool Works. Stedman & Co. had a general machine-shop business, building also plain slide-valve engines, saw-mills, farm machinery and pumps for plantations. The designing of large pumps for drainage and irrigation was a promising field which Mr. Reynolds proceeded to develop. Patents of the old Andrews pump and others were offered the firm, but none showed or promised satisfactory efficiency, so Mr. Reynolds decided to design a pump, and in connection with this scheme he made some crude experiments the results of which have been of value to him in connection with his largest and most daring work of later years.

The breaking out of the Civil War interfered so seriously with the business at Aurora that Mr. Reynolds left there and came East, with Boston as his headquarters for the next few years. These were no more years of idleness than the others had been. He took charge of a shop in Boston for Geo. T. McLaughlin, and besides that he was interested in the development of a number of special machines, either as designer or consulting engineer.

In 1867, Mr. Reynolds went to Providence as a general engineer and salesman for the Corliss Steam Engine Company, the Corliss plan of operations having from the first and always called for salesmen who distinctly were competent engineers. After four and a half years in this position Mr. Reynolds was made general superintendent of the works, which position he held until 1877. He had not held the position so long without suggestions and invitations to change. His old friend, Mr. Gaff, and also Mr. Gordon of the Niles Tool Works, tried hard to get him to take hold of that institution, offering an interest in the works or terms exceedingly favorable. Having declined this offer, the acceptance of a connection with the Allis Company may have a rather unaccountable aspect. The position held by Mr. Reynolds at Providence was then perhaps the highest in the engineering business in the United States. He went to the remotest corner of the manufacturing field, and connected himself with a firm practically unknown and in embarrassed circumstances. The firm had failed the year before, they had a ramshackle old shop; the foundry, which had been fitted up for pipe work, was of a piece with the rest; and, all told, only about 150 men were employed. It is scarcely probable that Mr. Reynolds foresaw what the business would so soon grow to, but he must have seen in it more or less clearly the opportunity of his life. Mr. Corliss had grown rich and dictatorial, seemed to believe that his word was law in steam engineering, and took the position, more or less pronounced, that any man who wanted the best engine must buy it of Corliss and must pay the Corliss price for it without question. In the meantime Mr. Reynolds, as events would seem to indicate, had ideas of his own about Corliss engines and other things. He evidently believed that the original Corliss engine could be greatly simplified and improved, that he knew the way, and that the improvements, combined with correct business methods, must result in the building up of a great business. There may have been more than a little of sympathetic benevolence in it also. Here was a concern in a bad way. Neither Mr. Allis nor his sons had engineering knowledge or ability. He could help them, assume an independent position for himself and find full employment for his teeming engineering ideas, and so he became the engineering brains of the Allis works. The first and most essential thing was to place the business on a paying basis, and this was done almost at once through the building of the Reynolds-Corliss engine. The first engine was a 14x36-inch girder-frame, Corliss, stationary engine. This was sketched on the back of an envelope during a ride from Milwaukee to Chicago after his first visit to the scene of what were to be his life's greatest successes. This design was not his best on general principles, but the best to build with the shop equipment at that time. This, it will be understood, was not only miserable, but there were no means at hand for the purchase of better. The first tool put into the shop after Mr. Reynolds took charge was an eight-foot boring mill furnished by Mr. Reynolds' old friend, Mr. Gaff of the Niles Tool Works. Mr. Reynolds had to and did design the thing which it was possible to build in the shops as they stood, without spending a cent at first for equipment. It was necessary to compromise, not only with the machine shop, but more especially with the foundry, which was worse, and even the facilities, worst of all, for transporting the castings from the foundry to the machine shop had to be yielded to. The frame, then, was made in two parts, so that it could be handled, so that either right or left could be made from the same pattern, and so that, in deference to the lack of skill in the foundry, the core work was reduced to a single simple core in the jaw. At a later time, when the demands of the business were growing faster than the facilities, the wrought iron frame engine was designed as a means of relief. The Reynolds engine of 1890 may probably be said to be the first design in which serious concessions have not been made to the facilities of construction or other imperative conditions. Mr. Reynolds' method of work has seemed to be first to make a careful study of all the conditions of the individual case, and first of all with reference to the underlying engineering principles. On these for a foundation he would work out the simplest machine possible, remembering always the possibilities of the shop as well as the idealities of the drafting room. This has usually practically ended the matter. Once the design has been decided upon he has been prepared to fight for it, and usually successfully, and a very large part of the Allis business has been obtained, not so much by underbidding in price as by embodying the best engineering features.

Of the rapidly succeeding successes of Mr. Reynolds as an original and independent engineer it is not necessary to speak, as they are sufficiently familiar to the profession. The blowing engine designed for the Joliet Steel Company stirred up the experts. Although Mr. Reynolds' design marked a radical departure from previous

types, its valuable features were recognized at once and secured the contract. Andrew Carnegie ordered one like it before it had been running a month, this being the beginning of $5,000,000 worth of work for the same company. The steam ore stamp was also a novelty, showing an increased efficiency of 50 per cent. and adding much to the value of the great copper properties. Mr. Reynolds has been a leader in the development of the modern pumping engine and in introducing compound and triple expansion engines in factories and power houses. He was the first to build the low-speed direct-coupled type of engine and generator. The large screw pump at the Milwaukee Flushing Tunnel was a success in another field.

Among the more recent work of Mr. Reynolds is the combined horizontal and vertical reversing engine built for the American Steel & Wire Company at Worcester. The cylinders of this engine were both high pressure, 44x60 inches, the construction leaving one end of the shaft free for direct connection to the rolls and doing away with the gears, which have always been an objectionable feature. In the engines for the Manhattan Elevated Railroad, of this city, the problem of getting a maximum of 12,000 horse-power in one unit, without undue weight on the bearings, seems to have been very simply solved, and the weight of the flywheel has been reduced one-half.

This engine may be taken as illustrative of the building up of the Allis business by Mr. Reynolds. In the final settlement of this contract for three engines it was secured because as an engineering proposition the design submitted was so superior to others offered in competition that the price was a secondary consideration. As a sample of the confidence in Mr. Reynolds' judgment and skill, $3,000,000 worth of this type of engine were ordered in a lump before one of them had been built and erected.

We have spoken of Mr. Reynolds' engineering successes exclusively. It must not be forgotten that he has been also the man of business, and it has been by the combination of the engineer and business man and all-around manager that the business with which has has been associated has so marvelously grown, so that it is now building a shop which will cost nearly $3,000,000 and will undoubtedly be the largest and most complete machine shop for the class of work ever built.

Mr. Reynolds was held in the highest esteem by Mr. Allis. He was made by the will one of the trustees of the Allis estate, and on the reorganization of the business he was elected second vice-president of the company. The University of Wisconsin conferred the degree of LL.D. upon Mr. Reynolds and later placed his name upon the frieze of the new engineering building. His election to the presidency of the Mechanical Engineers is a recognition of his eminence in the profession which the society honors itself by conferring.

Annual Meeting of the American Society of Mechanical Engineers.

The American Society of Mechanical Engineers commenced its twenty-second annual meeting in this city on Tuesday evening, December 3. The local members and a large number from various parts of the country thronged the society house at an early hour, emphasizing more strongly than ever the entire inadequacy of the building for its supreme function of providing a suitable place of meeting. Comfort and convenience were sadly lacking, although the universal good feeling made even very bad conditions more than endurable. The number present at this first meeting was greater than ever before, and the crush and the practical impossibility of doing as one would wish or of going where one would or should, was more pronounced than ever.

The only formal business of this first session was the address of the retiring president, Mr. Samuel T. Wellman. Not more than one-half of the members present were able to crowd into the meeting room, the others filling the reception room, the halls, the stairs and every available corner. Those outside the meeting room and unable to enter it naturally took no interest in what they could neither see nor hear, and they proceeded to have a good time in such other ways as were possible. The president's address was therefore delivered under extremely unfavorable conditions, and many of those who were so fortunate (?) as to find sitting or standing room within sight of the speaker had great difficulty in hearing what was said.

Following the very practical and sensible precedent of the society, the president's address dealt with the precise technical matters with which its author was most conversant, the closely adhered to title and topic of the address being the "Early History of Open Hearth Steel Manufacture in the United States." The address was mainly a rehearsal, entirely without ostentation, of the life work of Mr. Wellman as one of the most responsible and efficient workers in the development of open hearth steel manufacture in the United States. The address followed almost precisely the same lines as those of the sketch of Mr. Wellman's life published in our columns upon his assumption of the presidential office one year ago, only that he described in more minute technical detail the successive furnaces and processes employed and the numerous difficulties encountered and successively surmounted. Mr. Wellman at the end indicated how rapidly and completely the basic process of open hearth steel manufacture is usurping the field. Mr. A. L. Holley, with whom Mr. Wellman was long and intimately associated, is reported to have once said that open hearth steel would one day attend the funeral of Bessemer steel, and while Mr. Wellman thought that this would not quite be consummated, it would still be a close approximation to the fact.

After the address luncheon was struggled for in the room in the basement, the available space for this ceremony being quite as inadequate as any of the rest. The "smoker" continued until a late—or early—hour.

WEDNESDAY MORNING SESSION.

The program had appropriated this session to business matters. The first subject to receive attention was the report of the tellers of election, who reported the election of officers in accordance with the official slate. Retiring President Wellman thereupon appointed Past President Fritz and Mr. Swasey a committee of two to escort President-elect Reynolds to the platform.

The printed annual report of the Council was then distributed and read by the secretary. This report deals at length with the proposed increase of dues and, as a matter of record, repeated the circulars on that subject which have already been sent to the members by the Council. The fact of the indebtedness of the society to its printer was announced in the last circular sent out, but the members were surprised, to put it mildly, to find by the report that the amount of this indebtedness is no less a sum than ten thousand dollars, and in the subsequent discussion it appeared that other items increased the total outstanding indebtedness to about thirteen thousand dollars.

The reading of the report was followed by the formal introduction by Mr. R. W. Hunt of the resolution to amend the constitution in order to increase the dues. Mr. Hunt was an avowed advocate of the increase and stated that he was such because of careful consideration of the question. He considered that the present tendency of things was directly toward bankruptcy. The discussion which followed was very animated and earnest, but upon a distinctly high plane and, with a single exception, entirely without acrimony. The exception was by Mr. Boyer, a member of the Council, who seconded Mr. Hunt's motion and proceeded to lampoon the technical press for having interfered in matters in which, he seemed to think, it had no business. The program for an increase was, he said, going through smoothly enough, when the technical papers interfered, and by their statements and their proxies had created unpleasantness. After hearing the facts, the members present could not vote other than in favor of the increase, but the absentee proxy vote was not informed regarding the facts and could not vote intelligently. But for this proxy vote the amendment would have carried without difficulty—a remark which brought forth derisive laughter from the audience. The further discus-

sion showed that the members of the Council had not known of the real condition of things until very recently.

Mr. Towne followed with an admirable statement of the situation as he saw it. He regarded the condition of the society as far less serious than appeared upon the surface. As an ex-President he was a member of the Council and had signed the circulars, but further consideration had led him to modify his views as to the serious nature of the situation. By an analysis of the accounts of the society he had learned that the deficit had first made its appearance in 1897 and that it had since then steadily grown larger at an average rate of about $2,400 a year, which amount he did not consider large enough to be alarming. The increase of dues proposed by the Council would bring in additional revenue to the extent of about $18,500 a year, which he considered excessive when compared with the deficit. He finished by saying that at the proper time he should move that the increase be one half of that proposed, and stated that he did not think there would be any difficulty in relieving the society's embarrassment for the time being. If there had been any tendency to an acrimonious discussion it was headed off by the excellent taste of Mr. Towne's remarks, and especially by his frank acknowledgement that the Council were at fault in not having scrutinized the affairs of the society more closely, and that as a member of the Council he accepted his share of the blame.

Col. Meier followed Mr. Towne and regretted that he was obliged to differ from the Council, but he did so largely because of his knowledge of the views of distant members. He considered that resident members should pay more.

Mr. Cary considered that to decide the matter now would be hasty. The discussion should be printed and distributed among the members for their information and the resolution should be laid on the table for action at a future meeting. This idea received considerable discussion, but it was ultimately decided to take a vote on the adoption or rejection of the proposed change.

Mr. Rogers opposed raising the dues, especially to the Juniors, and thought the existing embarrassment could be overcome by a loan from the members.

Mr. Sinclair, in some very plain words, stated that the Council were at fault for not knowing what was going on. It was absurd to compliment the Council on their conduct of the affairs of the society when, without knowing it themselves, they had allowed the society to run into debt. Not long ago the society was paying off its debt and this abrupt change of affairs was incomprehensible to him.

Mr. Warner did not believe the proposed increase in dues a serious matter. Membership in the society is worth it. Once the society was a ten-dollar affair, then it grew to be a fifteen-dollar affair, and he believed that it was now a twenty-five dollar affair. He hoped that it would become a hundred-dollar affair. The case was similar to that of the appropriations of the government. The appropriations had grown to a billion of dollars because the country had grown to be a billion-dollar country.

Mr. Cox considered the policy of having a class of life members a mistake. If the policy was to be continued at all, the price of a life membership should be raised.

Mr. Rockwood did not consider the real question to be: what shall the dues be? but what do we want to do as a society and what dues are necessary to do it?

Mr. Platt referred to the statement of the Council regarding the dues of the English Institution of Civil Engineers and said it was erroneous. He corroborated the statement of Engineering News regarding this matter, and compared the work of that society with our own in a manner very unfavorable to the latter. He stated that, until late in October, the Council did not know the facts—not even that the society was in debt.

Mr. Forney opposed the increase. He did not consider membership in the society worth twenty-five dollars a year to many members. He opposed any postponement or evasion of the question. The members came to the meeting to vote on the question and should do it.

Mr. Halsey referred to Col. Meier's suggestion to increase the dues of resident members. The correspondence of this paper had shown a strong feeling among the non-resident members in favor of this action. So far as the actual use of the house by local members was concerned, the views of non-resident members were largely imaginary, but the holding of one meeting of each year in New York was a real advantage to local members, as they attended it without cost. The amount subscribed to the entertainment fund did not nearly offset the expenses of those who came to the meeting from a distance. He believed that the feeling of the non-resident members was just and that the dues of resident members should be increased. The members at large knew but little of the problems of the Council, but they referred to the experience of the Civil and Mining Engineers and were right in asking why this society could not be run as economically as those. He defended the course of the technical press and believed that if the increase had been adopted by the votes of the members present, as originally planned, it would have broken the society in two.

Mr. Henning had investigated the conduct of foreign societies, especially the Society of German Engineers, which has dues of only five dollars a year. This society has sections in various cities wherever twenty-five members can get together. It has in consequence a membership of 16,000. It is thus a national society, which this society is not. That society publishes a weekly paper which returns a large revenue. He had drawn up a revised constitution which he would submit to the Council for their consideration and for presentation later to the membership.

Mr. Soule stated that he was a member of the Council and had signed the circular letters, but his support of the increase was only half-hearted. He considered the Council responsible for the condition of affairs. He hoped that, to avoid dissension, the measure would be voted down unanimously, but with the understanding that it is to be kept alive and considered further another year.

Mr. Morrison remarked that the dues are now as high as in other similar societies. It was one thing to raise them to this point, but it was altogether another thing to raise them above that point.

Mr. Kent wanted to know how it was that this deficit had existed for years and that no clew to it could be found in the annual statements of the finance committee and why the statement for the past year just distributed, like the others, gave no comparative statement of assets and liabilities from which the facts could be learned, but on the contrary showed for the society and the Library Association an apparent balance to the good of $80,000. What kind of bookkeeping is this?

The proposition to lay upon the table met with very determined opposition, especially from C. W. Hunt, who declared that the members were now ready to vote and that the voting upon the question should be proceeded with. He said he should demand the right to vote his proxies upon the question of tabling. The chair said that would be a matter for the members to decide, but Mr. Hunt said he should insist upon his right to vote his proxies irrespective of the decision of the members present and others holding proxies gave notice of an intention to demand the same right. Finally, the previous question being moved, the chair appointed Messrs. Suplee, Pomeroy and Fred J. Miller tellers and announced the method of voting by ballot and that the polls would close at 3 P. M. The voting was lively and far more proxies were voted than direct votes, many of the members voting large numbers of the former. M. N. Forney held over a hundred proxies, a large share of them being from mechanical officers of railways; Fred J. Miller held the largest number of proxies by any single member—162—all of which were voted in the negative.

WEDNESDAY AFTERNOON SESSION.

The process of verifying and counting proxy ballots is a long one, and the tellers were not ready to report at the opening of the session.

Mr. Towne made a statement for the Council that at a meeting the preceding afternoon it had adopted a resolution for the appointing of a committee to investigate the affairs of the society and appraise its property—employing, if necessary, an ex-

pert accountant for that purpose. One of the things in view is the inauguration of a better system of bookkeeping and the placing before the membership each year a detailed statement of the financial affairs of the society.

Mr. Rogers offered a series of resolutions which had been prepared in ignorance of this action of the Council which were of similar import, except that they stipulated that the committee be composed of members not holding office. Nothing was done with these resolutions.

Mr. Baker offered an amendment to the constitution providing that in future amendments to that document should be by a mail ballot. In order to discourage mere tinkering the resolutions provided that such amendments should first pass the members present at a meeting in order to get the standing which such a vote would give them and that after receiving the approval of those present at a meeting they should go to the membership at large.

Mr. C. W. Hunt explained that the proxy ballot was provided by law and that such a mail ballot could not affect a member's right to vote by proxy. In reply to this, Mr. Baker explained that his method was intended to provide a less cumbersome method and one which would satisfy the members without resorting to the more clumsy proxy method. After considerable discussion it was moved and carried that it was the sense of the meeting that such amendment to the constitution be passed. In this form the proposition goes to the Council.

THURSDAY MORNING SESSION.

The result of the ballot on the proposed increase of dues was announced at the opening of the session, the figures being 647 against and 191 in favor, and the amendment was overwhelmingly defeated.

Preceding the regular papers the meeting proceeded to a consideration of the

Topical Discussions and Notes of Experience.

WHAT DOES IT COST TO RUN TRAINS AT HIGH SPEED?

The raising of this question for discussion grows out of a resolution by the Western Railway Club asking the American Society of Mechanical Engineers to discuss it. Professor Hutton opened the discussion by giving an abstract of a paper on the same subject which was read by Mr. F. A. Delano before the Western Railway Club, together with abstracts of the discussion upon it.

The discussion was opened by Col. Haines, who explained that a complete formula to cover the case must include much more than the mere subject of train resistance. He stated that the formula given in the preceding abstract is not recognized by any competent authority. He stated further that the matter of high-speed trains was chiefly one of competition and emulation among railroad companies. From the economic standpoint it was dwarfed by the problem of the most economical speed of freight trains. That problem is, "What is the cheapest speed at which a given tonnage of freight can be moved?" The question is a very simple one to give, but it is an extremely complicated one to answer.

Mr. Pomeroy detailed some experiments on coal consumption and used these to illustrate the exaggerated importance which many attach to the results obtained in this way, even when they are correct. In this connection he stated that an increase of 50 per cent. in coal consumption would mean an increase of only from 3 to 5 per cent. in the total cost of operating the trains. In a similar manner a statement of the comparative repairs required for trains of different speeds had much less importance than appeared upon its face.

Mr. Forney explained some of the features of the problem which are not always recognized. Thus, the condition of the roadbed determines in large measure how much increased damage is done to it by increased speed. Similarly the question of whether the locomotives were able to do the work easily or not was of importance in the matter of cost. He considered the incidental expenses the most important of all. The saving in fuel due to low speeds is in large measure offset by the loss in train service given.

Mr. Barth remarked that in such matters undue importance was often attached to the mathematical maximum or minimum, as the case might be. It often happens that the shape of the curve when plotted was such as to be compartively flat in the vicinity of the maximum or minimum value and that for a considerable distance each side of those values the choice was very small.

SOME PECULIARITIES OF SPRINGS—A SPRING-TESTING MACHINE.

This topic was opened by Mr. S. W. Baldwin, who pointed out the freedom from teetering action by a leaf spring as compared with a coiled spring due to the friction of the leaves of the former upon one another. He also referred to a machine for recording these oscillations on a moving piece of paper and gave diagrams from it taken with both types of springs.

Mr. Cary presented a written discussion. He considered that Mr. Baldwin's diagrams showed imperfect spring action. He considered it to be proven that tempering steel for springs or other purposes did not change its modulus of elasticity, the chief effect being to raise the limit of elasticity. This was quite contrary to the belief of many, but it was well proven. He considered a torsion test of the wire of greater value than a test of completed springs. He considered the leaf spring the least satisfactory of all forms.

THE LINVOLPON SYSTEM—A SUGGESTION FOR A NEW DECIMAL SYSTEM OF MEASUREMENTS BASED ON AN OLD UNIT.

This topic was opened by Mr. F. F. Nickel, who described the system. It takes 1/8 of an inch as the basis and takes ten of these or 1¼ inches as the unit, which is called the Lin. The units of area, volume and weight are then derived from the unit of length in a manner analogous to that by which the corresponding units of the metric system are derived.

There was no further discussion of this topic, the system proposed being apparently not taken very seriously.

THURSDAY AFTERNOON.

UNVEILING THE FULTON MEMORIAL.

The annual meetings of the society have each usually a distinctive character by the occurrence of some event out of the usual routine of society business, and the present meeting was no exception. The special event in this case was the unveiling of the monument to the memory of Robert Fulton, placed in Trinity churchyard by the contributions of individual members of the society. Although Fulton was buried in 1815 with distinguished honors, and in the vault of one of the most distinguished families of the city and State—that of Chancellor Livingston—it has been a strange and reproachful fact that not even his name has been visible to mark his resting place, and no memorial erection has recalled his fame. The monument at last provided, and shown in the accompanying picture, is not unworthy of the society or of the distinguished dead, and it is creditably placed.

The exercises throughout were dignified, appropriate and impressive. Rear Admiral George W. Melville, Chief of the Bureau of Steam Engineering and an ex-president of the society, delivered an eloquent eulogy upon Fulton and his life work. He sketched briefly the rapid and complete transformation and advancement in travel, in commerce and in the methods of war which resulted from steam navigation, and he pointed out the particulars in which the genius and the success of Fulton consisted. It was not in the invention of this or that mechanical device, not even in the actual propulsion of a vessel by steam power, but in combining and compelling all the conditions necessary to constitute an actual, practical, abiding and advancing commercial success. He did not try to invent or develop a new steam engine, but imported a Bolton & Watt engine from England, and the hull of his first steamboat had no striking features of difference from many other vessels of the time. He showed the true genius of the practical inventor in the constant succession of improvements in the vessels which succeeded the Clermont. Fulton built the first steam-propelled ship of war, and was the father not only of the modern American navy, but of all the navies of the world. The admiral before closing referred to the presence at the meeting of the nonogenarian, Charles H. Haswell, the first chief engineer (1836) and the first engineer-in-chief (1844-1850) of the United States Navy.

It had been arranged and was expected that Commodore B. F. Isherwood, who was engineer-in-chief throughout the Civil War, would have been present, but he was prohibited by his physicians. He sent a letter which the time would not permit to be read, but which will appear in the "Transactions." He wrote: "In meeting to erect a monument to Robert Fulton we do honor to ourselves. He does not need our recognition or our homage. Wherever a steamboat floats there is a monument to Fulton."

THE ROBERT FULTON MEMORIAL IN TRINITY CHURCHYARD, NEW YORK.

Dr. Robert H. Thurston, of Cornell University, also an ex-president of the society, spoke briefly of the career of Fulton, showing that he was a much greater all-around man than commonly estimated. He was an artist of no mean ability, and was all his life an appreciative promoter of art and letters.

After these exercises a procession was formed, with President Wellman, Admiral Melville, Mr. Haswell and Dr. Thurston and sixteen descendants of Robert Fulton at the head, passing aross the churchyard and into Trinity Church, where a solemn memorial service with full vested choir was gone through with. At this service, conducted by Dr. Morgan Dix, an address was delivered by Rev. Robert Fulton Crary, of Poughkeepsie, a grandson of Fulton. This address went into some curious details of Fulton's ancestry, showing a presumption that he was descended from a Dr. Fulton, who in the seventeenth century was chaplain to Lady Arabella Stuart of the Royal Family of England.

At the conclusion of the services in the church the flag was lifted from the monument by President Wellman, which concluded the exercises. The committee in charge of the memorial movement throughout consisted of Messrs. G. C. Henning, C. W. Hunt and Henry H. Suplee.

THURSDAY EVENING SESSION.

The first paper taken up at this session was

A Portable Accelerometer for Railway Testing.

BY F. B. COREY.

This paper is a description of a very interesting piece of apparatus for measuring the acceleration of railway or street cars. The mass acted upon by the accelerating force is mercury contained in a horizontal passage, the rise and fall of the mercury in two short vertical columns being the means by which the acceleration at any moment is read. This movement is, however, multiplied by alcohol columns resting on the mercury and of smaller diameter than the mercury columns. The instrument is graduated to give, by direct reading, the actual acceleration in miles per hour per second and in pounds of accelerating force per ton weight of car or train.

The instrument is not directly self-recording, but is made so, in effect, by a moving strip of paper driven by clockwork, the recording pencil being manipulated by hand so as to follow the fluctuations of the alcohol column, and this construction is stated to be entirely satisfactory.

The paper was discussed at some length by Mr. Wilfred Lewis, who described and showed an instrument of his own for a similar purpose which he had termed an inertia indicator. This instrument has been published in these columns. He did not regard the instrument described in the paper as entitled to be called an instrument of precision. He considered the method of recording the indications by following them by hand as far from satisfactory. This instrument, as well as his own, had the defect of being subject to lag, whereas a really satisfactory instrument for this purpose should be instantaneous in its action. This, however, is imposible if the indications are to be made through the action of forces on a mass of material. He did not profess to know which of the two instruments was superior and thought the matter a suitable one for a comparative test. He thought that a rider similar to those used on maximum thermometers might be a desirable addition. The movements are in many cases so quick as to make it impossible to follow them with the hand or even to read them satisfactorily. He was satisfied that there was quite a field for a real instrument of precision for this purpose.

Mr. Fowler considered an instrument which required to be read by the eye to be seriously defective, as the eye cannot follow the changes quickly enough. He described a recording instrument which he had used, but it is impossible to describe this here without illustrations.

Mr. Kingsbury considered that recording the indications by following them with the hand was desirable for some purposes. He considered the statement that it was necessary to stop the indicator repeat-

edly to allow for grades to be a confession of imperfection.

The next paper taken up was

A Bonus System of Rewarding Labor.

BY H. L. GANTT.

This paper is the result of a trial of the system described on a large scale in the large machine shop of the Bethlehem Steel Company, the result of this trial being "an unqualified success" and "a complete change in the whole atmosphere of the shop."

The workman is given an instruction card for each piece of work which shows the best method of performing each operation, specifies the tools to be used and sets the minimum time in which the work can be done. Should the workman do the work in this time he gets a large extra reward, but if he falls short, by ever so little, he gets nothing but his ordinary day rate.

The fixing of the time in which the work can be done is by an application of Mr. F. W. Taylor's system of elementary rate-fixing, which was described by Mr. Taylor in a paper published in Vol. XVI of the Transactions. This fixing of the time requires, of course, expert knowledge and skill, but the results obtained are stated to be "so great that the expenditure to acquire the knowledge is comparatively insignificant." These results are said to have been an increase of from 200 to 300 per cent. in output, a falling off in accidents and break-downs and a quickening of the intelligence of the men.

The discussion was opened by Dr. Thurston. He enlarged upon the importance of the subject and stated his conviction that the present wage system must be improved if we are to avoid trouble. He considered the educational feature of the methods described one of the best features of them.

Mr. Halsey thought that too little had been said about the elementary rate fixing department referred to in the paper and also given by Mr. Taylor in the paper referred to above. He had no doubt that Mr. Taylor had done all that he claimed, but it had not been described in a manner which would enable anyone else to do the same thing. He referred to the nature of the work at Bethlehem and considered several of its features to be unusual. The work was all large, much of it very large and some of it the largest. The shapes were simple, and but little finishing was done, the matter being thus reduced to a question of surface and depth of cut. More important still, perhaps, the material is made upon the ground and its qualities as regards hardness and workability are consequently well known, and in fact had been reduced to a scale depending upon composition. A given piece of work was seldom repeated, making the setting of a time limit by estimate a matter of necessity, if it is to be done at all. The fact that the work was large made it feasible to spend an amount of time and expense in determining these matters, which would be economically impossible with small pieces, and the fact that the shapes were simple and that the cuts were roughing cuts only made it more feasible to make these calculations in each case than it would be otherwise. In view of the results exhibited it would be a very ungracious task to attempt to find spots on the sun, but his idea was that while the system had undoubtedly accomplished great things at Bethlehem its field of application was nevertheless limited. He did not feel like attempting comparison with the premium plan, as might be expected of him. He had never presented the premium plan as a perfect thing or an ideal thing and certainly not as the only good thing. He considered that in point of fact its chief merits lay in the fact that it was a simple and flexible thing, and he knew that it was in use by many men and in many places where the elaborate nature of Mr. Taylor's ideas would prevent them being even considered.

The discussion on Mr. Gantt's paper was continued by Mr. Buckley, a foreman of the Bethlehem Steel Works, both before and after the adoption of the system. He endorsed the system in the most emphatic manner, and remarked more especially upon its educational features.

The discussion was continued by Mr. Taylor, who quite captivated the audience by his earnestness. He began by referring to his paper on a "differential piece-rate system" referred to above. In that paper he described his system of piece work, and also what he called his elementary rate-fixing department. The piece-work system described had received a great deal of attention, but the rate-fixing department, which he considered far more important of the two, had been discussed but little. He proceeded to answer Mr. Halsey's question regarding the rate-fixing department, and took as an illustration the methods followed in his investigations regarding the simple operation of shoveling dirt. He had investigated this subject exhaustively. These investigations had required two college men, with one or two assistants, for about two and a half years of time. These men were equipped with stop-watches having dials graduated so as to read to hundredths of a minute instead of seconds. The act of handling a shovelful of dirt was divided into two or three elementary operations, because these elementary operations differed from each other. Thus, the length of time required to push the shovel into the material to be handled depended upon the hardness, coarseness, etc., of that material, whereas the time required to throw the shovelful depended upon the hight and distance to which it was to be thrown. They found in the course of these investigations that for the average man a shovel capable of holding from 12 to 14 pounds of material was the most effective, but that a man especially well fit for the work did best with a shovel holding about 22 pounds. Whereas formerly one size shovel was used for all work, they had now a large variety of sizes and consequently used in all cases a shovel suited to the man and material to be handled, this shovel being selected in order to give the correct weight of material to be handled for the shoveler and for the material. The result of this inquiry was shown in the number of laborers, which decreased from something over 400 to 85. On the other hand, whereas before the change the men were paid $1.15 a day they now—through the application of piece work—were able to earn an average of $1.85 a day. To the best of his knowledge the rates paid were lower than anywhere else in the United States, and yet under the system the earnings advanced from $1.15 to $1.85 a day.

In a similar way the question of handling and loading pig iron, of which the company had of course much to do, had been investigated. Before the investigation, and the selection of the men growing out of it, the men doing this work had been paid $1.15 a day, which figured 9 cents a ton. At the present time, and as a result of this work, the rate paid is 4 cents per ton, while the average wages of these men is about $1.85. They found, however, that only about one man in fifteen could stand the pace. Those who could not stand this work were shifted to other work, but after the wages earned had become known, additional men began to flock to the works for employment, the result being that they now have a picked body of men for the work.

In applying piece work in a machine shop it is difficult to know just where to begin. He concluded that the place to start is with the foremen. The duties of the foremen, as things are commonly conducted, are too general and indefinite. A good foreman is almost impossible to get, and this had been one of his chief embarrassments. To get over it, he had resorted to what he called "divided foremanship." While it is extremely difficult to get competent foremen, it is not difficult to instruct the average man in one of the elements of foremanship. This could be done in a couple of years or so, whereas the training of an all-around foreman he considered a matter of twelve or fifteen years. What he meant by "divided foremanship" was explained, as related to the machine shop, by saying that in the shop one of these foremen is the "speed boss," whose sole duty it is to see that the proper speeds and feeds are used on the machines; another foreman is the "gang boss," who prepares the work and sees that each machine has at least a day's work ahead, with the necessary drawings, gages, and other tools for doing the work; a third foreman is the inspector, who is responsible for the quality of the work, and for nothing else. The fourth foreman devotes himself ex-

clusively to time records, cost reports, etc. Then a set of men have charge of the making out of the instruction cards, which were described in the paper. And, last of all, is the disciplinarian, whose duties largely explain themselves.

At the start the most difficulty is found in getting each of these foremen to attend to his own duties and to leave those of the others alone, but finally they become a harmonious team and pull together. He did not consider "divided foremanship" a permanent necessity. He thought that finally some of the functions could be combined; but he regarded it as necessary at the start.

The chief difficulty of all is experienced after the period of investigation has been passed and the necessary data have been collected, and the concern is ready to introduce piece work. They had reached this stage at Bethlehem and were ready to take this final plunge when Mr. Gantt made the suggestion of his bonus system, which differs from piece work in that it offers a reward for reaching the desired output instead of compelling the men to accept piece rates. No system of piece work should be considered a finality which does not include the absence of antagonism between employer and employees. It is essential to this that the employer should carry out his side of the bargain in good faith and not cut the rates.

He regarded the rate-fixing or time-study department as a fundamental necessity, and, in fact, just as important as a drafting room. He was ready to predict that in thirty years' time a shop without such a time-study department would be as much behind the times as an engineering department to-day without a drafting room. It is just as illogical to depend upon the workmen to determine how the work is to be done as it would be to expect them to design and lay out the work among themselves.

The usual objection to this system is that it must involve heavy general expenses. To this his reply was that the work must be done in any event and that the real innovation was the placing of it in the hands of trained men, instead of leaving it in the hands of those that have no special training. More than this, by the usual plan, while this work is being done, the machine stands idle and its output is stopped. From this standpoint he regarded the instruction cards, showing just how to handle each piece of work, as the most important part of the system. His first use of these cards was in connection with the operation of cleaning boilers in a works in which they had many boilers and a regular gang of boiler cleaners. His ideas were looked upon with derision, but under this system the cost of doing the work was reduced from $60 to $11, and the same instruction card continued in use for a period of fifteen years.

The president was compelled to remind Mr. Taylor of the lateness of the hour, and he broke off, apparently, in the middle of his story, and in doing so received a round of applause.

Professor Higgins was the next speaker. He said that the method described might look as etherial or spiritual, but he was very much impressed with what he had heard. He feared that the methods of Mr. Taylor were so much in advance of existing methods that we were in danger of casting them aside as visionary, but he believed them so practical and scientific that it is quite possible they may mark the beginning of an epoch in industrial matters. He believed that they could be developed to so great an importance that they may determine our standing among the nations.

Mr. Dodge stated that his company had become enamored of Mr. Taylor's personality and ideas, and had tried them. The first result of this trial was profound humiliation on their part to find how little they knew of their own business. The first thing to do when adopting the system is to ignore your personal pride, put yourself in the background and look on. On Mr. Taylor's urging they had "charted" their shop, which required a vast amount of labor, but after the chart was finished a single hour's study of it pointed out annual savings aggregating $3,600. They now find it necessary to increase their plant investment by 60 per cent. in order to follow Mr. Taylor's lead, and they are doing it cheerfully.

The next paper to be taken up was

A Silent Chain Gear.

BY J. O. NIXON.

This paper deals in an interesting way with what our readers know as the Renold silent chain gear, the principles and construction of which were set forth in an illustrated article which we published at page 361, volume for 1898.

The author of the paper, after stating the generally recognized difficulty with transmission chains—*i. e.*, the fact that the chain begins to increase its pitch as soon as it begins work, and that therefore one tooth on each wheel bears all the load and there is, sooner or later, a distinct jump from one tooth to the next, causing noise and rapidly destructive shocks. This limits ordinary chains to very low speeds, and the Renold chain, by overcoming this difficulty and providing a means whereby the chain automatically adjusts itself to the sprockets, no matter how much wear may have taken place, within limits, overcomes the difficulty and runs silently at speeds before not thought of in connection with chain transmission. In fact the author says:

"The only factor so far found which serves to limit the speed is the difficulty of keeping the lubricant on the chain at very high speeds. At speeds exceeding 1,350 to 1,400 feet per minute, the oil is thrown off by centrifugal force, but speeds as high as 2,300 feet have been employed successfully by enclosing chain and wheels and running them in oil. The particular case in mind was the transmission of 75 horsepower from the motors to the car axle on the Mono-rail Railway, at the Brussels Exposition. This is the type of road which is soon to be erected between Liverpool and Manchester."

He sums up the case for the chain as follows:

"The Renold silent chain gear possesses, in common with all chain gears, these advantages: (1) A positive speed ratio (no slip); (2) no tension in the slack side of the chain, and therefore a minimized loss in journal friction; (3) adaptability to short centers or to long centers; (4) adaptability to hot or damp situations. In addition to these it possesses the following unique advantages: (1) It is silent; (2) it may be run at high speeds; (3) the initially perfect action is preserved throughout the life of the chain (4) the load is distributed over all the teeth in mesh. It is superior to leather or rubber belts because—(1) It provides a positive speed ratio; (2) there is a minimum loss in journal friction; (3) it can be used in hot or damp situations; (4) it can be used on short centers without a troublesome and wasteful idler. It is superior to spur gearing because—(1) It is noiseless; (2) it does not require fixed centers; (3) it does not require short centers; (4) there is no sliding friction on the teeth, hence it is more efficient; (5) it is smoother in action and generally more durable. The writer believes that no one who has given the subject even casual thought will dispute the assertion that the development of the Renold silent chain gear marks an era in the history of power transmission."

In the discussion Mr. Emerson stated that he had been studying the chain for some time. He considered that the claims made in the paper were true, but he thought the common chain was better than the paper indicated.

Mr. Dodge said that when negotiating with Mr. Renold regarding the manufacture of his chain he had told them that they would probably find it necessary to import their material, but they had found much of it here which was so satisfactory that Mr. Renold was now using some of it himself. Some of the special high-grade material was, however, made in Belgium and used both by Mr. Renold and themselves.

Following this came

The Bursting of Small Cast-Iron Flywheels.

BY C. H. BENJAMIN.

This paper is of a very unusual degree of interest. Three years ago Professor Benjamin read a paper before the society, in which he described some experiments in which small flywheels were tested to destruction by extremely high speeds, and the experiments here recorded are properly a continuation of those previously described, although the apparatus has been modified in the meantime. The forces

developed in these wheels are terrific, and for safety's sake the wheels were surrounded by a ring shield of steel having a rim section of 4x6 inches. This was covered, front and back, by oak planking 3 inches thick, and to absorb the energy of the flying fragments the steel ring was lined with Norway pine, which was crushed to splinters by the explosions, and required renewal after each test. Notwithstanding these precautions, one wheel succeeded in escaping from the shield through the breaking of the bolts which confined the side covers.

Sixteen wheels of 24 inches diameter were tested in this series of experiments, and the table of results is interesting and instructive in the highest degree.

Two solid cast-iron wheels broke at circumferential speeds of 387 and 403 feet per second respectively, while four made in halves and fitted with the common bolted joint broke at speeds ranging between 188.5 and 199 feet per second, showing that such wheels, when run at the traditional 100 feet per second, have a margin of safety of less than 2 to 1 as regards speed and less than 4 to 1 as regards the centrifugal strain. The location of the joint of this type of wheel at the points of contrary flexure—one-fourth the distance from one arm to the next—was of no appreciable advantage. On the other hand, the addition of tie rods leading from the joints to the hub increased the strength of the joint nearly 100 per cent.

One wheel was a complete working model of a flywheel for a blowing engine, the arms being cast with the segments and bolted between flanges of the central hub and the segments of the rim being secured together by shrunk-in links. This wheel gave way at 256.5 feet per second.

The author's conclusions are that solid wheels will require speeds of from 350 to 400 feet per second to burst them; that in such wheels the stresses due to bending ["beam action"] are negligible; that jointing the arms at the rim and bracing the rim by internal flanges have no important effect on the strength, and that probably no joint can be made for a rim of solid cross-section which will be more than one-third as strong as the rim itself.

Professor Benjamin in presenting his paper referred to the remarks of one of the speakers who, in advocating increased dues, had referred to his experiments and had remarked upon the small size of the wheels tested, adding that a most desirable use of the society's funds would be in aiding Professor Benjamin to increase the diameter of the wheels to 10 or 12 feet. To this he remarked that there were other considerations beside cost which would deter him from undertaking the testing of wheels of the sizes proposed. He thought that anyone who might be present at the testing of a 2-foot wheel would be satisfied that the limit of size had been about reached. He desired suggestions regarding additional forms of wheels to be tested.

The discussion was short and consisted chiefly of highly complimentary remarks regarding the value of the experiments. Two speakers referred to the fact that all the wheels tested had bulky rims and suggested that thin rim wheels for use with belts should be tested. Internal flanges might be found useful in such wheels.

Following this came the

Preliminary Report of the Committee Appointed to Codify and Standardize the Methods of Making Engine Tests and Discussions on the Same.

The report was presented by Professor Jacobus. It is voluminous, occupying, with the appended tables, suggestions and discussion, eighty-eight pages, and cannot be adequately summarized or abstracted here. Professor Jacobus explained the decisions on disputed points and stated that, with such further suggestions and discussion as might be received in the meantime, it was hoped to have the final report ready for presentation at the spring meeting.

Mr. Rockwood considered the report admirable, but regretted that it could not have been prepared ten or fifteen years ago, so that our now standard tests could have been made in accordance with it. There is now less interest in engine tests than formerly. We have collected a mass of data and settled nearly all controverted points. But one large subject remains unsettled by experimentation, namely, the ratio of the cylinders in compound engines. He was now engaged in experimental investigation of this subject and hoped to present his results in the not distant future. The handling of the steam consumed by the auxiliaries was a difficult matter which was complicated by the fact that in all our great tests the steam used for these purposes could not be separated from that used for power generation, because when those tests were made the auxiliaries were driven from the main engine.

Mr. Kent considered that but one mistake had been made in connection with this report—Mr. Rockwood should have been a member of the committee.

Following this came the

Final Report of Committee on Standardization of Engines and Dynamos.

Perhaps no committee of the society has done its work in a more thoroughly admirable and satisfactory manner than the one which here summarizes its labors in a brief report of ten pages. The length of the report gives no indication of the amount of time and labor which have been expended by the committee.

The object of the committee's labors has been to eliminate those unnecessary variations in the dimensions of dynamos of the same capacity which, since the direct-connected construction came in, have been a thorn in the engine builder's side because of the constant expense involved in accommodating these variations.

The results of the committee's labors are embodied in a table which covers units of capacities varying from 25 to 200 kilowatts and which gives standard dimensions for those parts which concern both engine and dynamo builder. The committee has in its membership representatives of both ends of the combination and has, moreover, been able to enlist the active co-operation of both engine and generator builders. The report being thus the result of a spirit of give and take on both sides, it will no doubt accomplish its purpose to the material benefit of both parties as well as of the purchasing public.

The report was presented by Mr. Rohrer. As the hour was late, the president requested that the discussion be sent in in writing.

FRIDAY MORNING SESSION.

This session was opened by the presentation by the secretary of

A New Valve Gear for Gas, Steam and Air Engines.

BY E. W. NAYLOR.

The gear described in this paper has valves of the poppet type which are located in the cylinder heads and are operated by electromagnets. The description is not as clear as is desirable, but our understanding of the construction is that the engine drives a pair of disks—one for the steam and one for the exhaust valve—which disks have sectors of conducting material on their surfaces whereby the circuits are alternately completed and broken, the magnets being thus energized and de-energized. The gear as illustrated is applied to a Westinghouse engine.

In presenting this paper the secretary read an additional communication from the author, the connection of which with the subject matter of the paper was not apparent. It related to the balancing of rotary engines and steam turbines and attributed the breaking in two of torpedo boats to the vibrations set up by their motors.

In the discussion Professor Barr considered the paper very incomplete in many particulars. The claims advanced were not substantiated and such evidence as was presented was irrelevant.

The next paper presented was

The Potter Mesh Separator and Superheater.

BY F. A. SCHEFFLER.

This paper gives a description of a device intended to perform the intended duty of a dry pipe in a steam boiler. The separator consists of a series of galvanized or copper wire meshes or screens enclosed in a suitable case and placed within the boiler. The term "superheater" seems to be scarcely applicable to the apparatus, as the drying effect is due to the mechanical removal of the water and to the slight wire drawing of the steam in passing the meshes. There is no addition of heat to the steam, and while the test reported in the paper shows a reduction in the percentage of entrained water, it does not show any superheating, nor indeed does it show even perfectly dry steam.

Mr. De Kinder considered the best form of separator or dry pipe to be no dry pipe at all. He could not agree with the author that the best designed boiler will foam and considered the claims absurd.

Mr. Wood considered the tests very incomplete and inconclusive. The observations were discordant. Nothing was said about the load and he considered that the change in the load was responsible for many of the variations in the observed data. The loss in pressure necessary to dry the steam was too serious to make the process desirable.

Professor Barr considered that there was little justification for calling the apparatus a superheater. The improvement in quality of the steam by wire drawing does not depend upon the apparatus used but upon the process. It could be secured just as well by the use of too small a steam pipe and it was stated in a misleading manner. This manner of stating it would show an improvement of 1,100 per cent. in some tests made by Professor Carpenter, which showed its absurdity. The apparatus might be effective in preventing the throwing of water in large masses, but the proper place for a separator was near the engine and not in or near the boiler. Drying the steam by wire drawing is a wasteful process.

Mr. Ashworth considered it erroneous to say that a well-designed boiler would throw water badly. To put any attachment within a boiler is wrong.

The author claimed in his rejoinder that well-designed boilers do throw water at times. He would submit his detailed reply in writing.

Following this came the presentation by Mr. Bond of the

Report of the Committee on Standard Threads for Pipe Unions.

The labors of the committee had shown that no standard threads could be decided upon which could be used in the various patterns of union now made and the committee had therefore enlarged its scope and designed a complete standard union. The plates for this design are included in the report. He recommended that this design be copyrighted and that the right to use it be issued to manufacturers for a nominal sum. The object of this is to prevent the offering of unions as standard which are not so. Several manufacturers of unions had co-operated with the committee, as had similar committees of the Railway Master Mechanics' and of the Master Car Builders' associations. These committees would present reports to their respective associations recommending the same design as standard. In accordance with the former precedents of the society, the report was accepted but not adopted.

The next paper on the program was

Working Loads for Manila Rope.

BY C. W. HUNT.

After pointing out the lack of definite available information regarding proper working loads for manila rope for hoisting purposes, the author of this paper proceeds to give, in extremely definite and satisfactory form, the results of his own extended experience as well as some examples of the life of rope in actual service.

The tables give the ultimate strength of different sizes of rope from tests by the C. W. Hunt Company, and figures are given for the working loads and the minimum diameters of sheaves for three classes of work, which are defined as rapid, medium and slow, these being explained as meaning 400 to 800, 150 to 300 and 50 to 100 feet per minute respectively.

Mr. Hunt presented his report in a model manner by saying it was not necessary to read it. The paper was considered to contain some valuable and needed data, but it was not discussed at any length.

The next paper presented was

The Heat Engine Problem.

BY C. E. LUCKE.

As the author of this paper is not a member of the society it was presented by R. H. Fernald. It is an elaborate analysis and comparison of the various cycles under which heat engines operate in order to determine their respective merits. The author considers that the balance of advantages lies with the cycle of the old Brayton engine. The paper also describes the experiments and apparatus of the author whereby explosive mixtures of air and gas are burned continuously and harmlessly.

Mr. Frith presented a written discussion. He considered the results of great interest and practical value, but considered the description and classification of some of the cycles open to criticism. He did not rank the Brayton cycle so high as the author. The recorded efficiency of the Brayton engine is low.

Mr. Suplee stated that Mr. Brayton had performed experiments before the Franklin Institute many years ago in which he had burned explosive mixtures harmlessly and by essentially the same apparatus as that described in the paper.

The author, in reply, gave his reasons for his description and classification of the cycles and gave his explanation of the observed low efficiency of the Brayton engines.

The next paper was

Experiments on Spiral Springs.

BY C. H. BENJAMIN AND ROY A. FRENCH.

The experiments recorded in this paper are fundamental in their character and are intended to determine the proper basic constants which depend upon the properties of steel. Twenty-seven different groups of springs were tested, each group being composed of several, and in some cases several hundred, springs. The outside diameters of the springs ranged between 3¼ and 9¼ inches, while the diameters of the bars of steel ranged between ½ and 1.3125 inch. The scope of the experiments is thus wide enough to make them of importance. We are not aware of any others which compare with them in scope, and the constants obtained will no doubt, in due season, be incorporated into the various pocket books. The author finds the average value of the co-efficient of torsional elasticity to be 14,700,000, the value which is usually accepted being 12,500,000. The particulars of the springs tested and the results of the experiments are given in a table and recommendations are made regarding the safe limit of stress in springs of different sizes.

Mr. Kent called attention to the large variation in the observed torsional modulus of elasticity.

Mr. Cary objected to the terms used, saying that what are really helical springs are called spiral springs. The standard formula for helical springs is based upon the assumptions that the applied forces produce torsional stresses only and that there are no internal stresses. He explained various ways of making and tempering steel springs. When the spring was wound soft and then hardened, there were no internal stresses and the formulas applied, but they do not apply to springs made by winding hard wire because of the internal stresses. He had made many experiments on both completed springs and on the wire composing them. By the former method he had found values for the modulus of elasticity varying between 10,000,000 and 16,000,000 and by the latter between 12,600,000 and 13,500,000. He considered the three diameter springs of the paper too small. He considered the minimum desirable diameter to be five times that of the wire. From seven to nine diameters gave the best results.

Mr. Fowler referred to the confusion which formerly existed about the subject of springs for railroad cars and to the experiments of the Pennsylvania Railroad which corroborated the Reuleaux formula. A large consumer like the Pennsylvania Railroad can specify the material, etc., which they know will produce the desired results, but the small consumer can only give his requirements and leave the rest to the spring maker.

Professor Benjamin regretted that Mr. French, who made the experiments, was not present. He considered the formulas for springs as satisfactory as any others dealing with the general subject of the strength of materials.

Following this came

Water Power Development at Hannawa Falls.

BY W. C. JOHNSON.

The plant here described is another illustration of the great influence which the development of electricity is having on the utilization of water power.

The paper begins by pointing out the great source of wealth which lies in the undeveloped water powers of the Adirondack region of New York, and then pro-

ceeds to describe the plant which has been erected at Hannawa Falls to utilize the power of the Raquette River at that point. A wood-pulp mill, which is located in the power house, is also described in the latter part of the paper.

There was no discussion on this paper and it was followed by

The How and the Why of the Porro Prism Field Glass.

BY W. R. WARNER.

This paper is a popular explanation of the principles and construction of the new binocular high-power field glasses which have become so prominent in recent years.

In order to make clear the characteristic features of the new glass the author also explains by sectional diagrams the basic principles of the Galilean telescope or "opera glass," the terrestrial telescope or "spy glass," and the astronomical telescope.

Incidentally he mentions many interesting things in connection with the manufacture of such glasses and among them the fact that glass is now made which absorbs only 4 per cent. of the light that passes through it. He takes the position that the claim that the objectives of this glass give a certain stereoscopic effect because they are farther apart than the eyes of the observer is untenable.

In the discussion Professor Emory asked for an explanation of the fact which had been observed by Mrs. Emory in studying birds with the glass, that the finer shades of color seemed to be obliterated by it, and Mr. Brashear, who does the optical part of the work, explained that it was due to a slight selective absorption from which the best optical glass was not entirely free, though great advances in optical glass have been made during recent years.

The last paper of the program was

An Experiment on the Effect of Clearance on the Economy of a Small Steam Engine.

BY ALBERT KINGSBURY.

The experiments here recorded are one series of several that were originally projected. The size of the engine tested was 5 1-16x7 iches, and it was of the shaft-governor type. The clearance was altered from the original by inserting cast-iron rings under the back cylinder cover. The clearance of the other end could not be conveniently altered and hence that end was thrown out of action, the engine being operated single acting. The loads were rather small, the mean effective pressure ranging between 18.7 and 21 pounds. A table of data and results is given, as is also a diagram which shows a regular but not great increase of water rate with the clearance. The clearance ranged between 10.82 and 32.5 per cent. of the piston displacement, and the small increase in the water rate between these wide limits of variation of the clearance will, we imagine, come as a surprise to those who look upon clearance as the chief inherent defect of steam engines.

Mr. H. E. Longwell considered the experiments defective in scope, because the smallest clearance used was, in fact, large. Had smaller clearances been used, he thought, the curve of results would have taken a rather abrupt change of direction. He submitted a diagram from tests of his own which showed that with light loads, and in combination with heavy compression, clearance was beneficial and not harmful, and other speakers corroborated this view.

Mr. Johnson pointed out that the volume of the clearance was not the only factor. We know nothing quantitatively about the effects of the extent of surface of the clearance space nor about the effects of varying degrees of polish.

Mr. Victorin presented a paper which was not on the program, in which were detailed the results of tests on the government testing machine at the Watertown Arsenal to determine the carrying powers of large rolling surfaces on a straight track. The experiments were undertaken in order to obtain information for use in designing carriages for large guns weighing up to 400,000 pounds. The tests were carried up to the full capacity of the testing machine—800,000 pounds. The paper was not in type and the experiments were not of a nature to permit a satisfactory abstract from the speaker's words.

As many members had arrived since the introduction of President-elect Reynolds, he was again presented by retiring President Wellman. Mr. Reynolds made a few felicitous remarks, saying that, however much he might doubt the wisdom of the society's choice in electing a "greasy mechanic" as its president, he fully appreciated the honor conferred.

After a vote of thanks to the various committees which had presented their reports the meeting adjourned. The attendance of members exceeded those of any previous meeting by over fifty, though the total registration of members and guests fell a few short of those present last year. The number thus registered was 749.

In addition to the proceedings at the Society House and at Trinity churchyard was the president's reception at Sherry's on Wednesday evening, which has become a regular feature of the New York meetings. The writer is not a competent reporter regarding ladies' gowns, and it must suffice to say that this occasion was as successful and enjoyable as former ones. It has been found that the hospitality of the society has been imposed upon at these receptions in former years, and, in consequence of this, admission this year was by card only. The next meeting is to be held in Boston.

The interests of capital and labor may be identical, but there are quite a few people who think they can tell them apart. —"Puck."

Reunion in Honor of Professor Sweet.

To those who were privileged to attend it, the reunion and dinner to Professor Sweet was the most enjoyable of all the events of the recent convention week. This affair had been arranged by those who call themselves the Professor's Boys and included both those who were formerly his students at Cornell University and those who have been graduated from the Straight Line Engine Shop. It had been in process of incubation for over a year.

The program consisted of a dinner at Muschenheim's with the presentation of a Jurgensen watch at the close. Largely through the absence of the professor in Mexico with the Mining Engineers during November, he had been kept in entire ignorance of the scheme, and through the co-operation of Mrs. Sweet he had been safely delivered in New York at the critical moment. The chief conspirator approached him the morning before the dinner with the remark that "several of the boys who had come to the engineers' meeting had suggested that it would be a nice thing to take dinner together at a restaurant and talk over old times." He was delighted with the idea and fell into the trap as unsuspectingly as it had been hoped he might. On arrival he found twenty-eight present, many of whom he had not seen for years and some of whom had never seen each other. This number naturally aroused his suspicion that something was up, but what that something was he had no idea until a second or two before the watch was placed in his hands.

The speakers had all been instructed to say anything on earth except to allude in the most distant manner to the watch, and in presenting it the speaker began by ambling and rambling as widely as possible from it in order to avert any suspicion of what was coming.

While the watch has a Jurgensen movement, the donors felt that the conventional gold case was altogether too commonplace a thing for the occasion and circumstances. Moreover, they desired to get away from the idea of a piece of jewelry and to look upon the watch as an instrument of precision, as it is, and to put it in a suitable case. The gold foundation ring, stem and winding button were of necessity preserved, but the back of the case, the crystal ring, dial and hands were removed and a new case and dial were made of steel treated by the Bower-Barff process, the figures of the dial being inset of gold and the hands being also of gold. In "Engineering" for 1872 was found a picture of the original Straight Line engine, which had an added appropriateness in the fact that it formerly drove the college shop at Cornell. A tiny reproduction of this engine was made in bas-relief, of gold, and attached to the back of the case. Inside the back of the case was the inscrip-

tion, "To Professor Sweet, from his Boys, 1901."

The general design of the case was entirely the work of the donors. It was made by Tiffany & Co., the treatment of the case by the Bower-Barff process being done by the Yale & Towne Manufacturing Company.

The program was carried out exactly as planned, and the event was a success to the last detail. Needless to say the professor was profoundly affected. It was unanimously voted at the conclusion to repeat the dinner annually, with the professor at the head of the table and in company with the wives and sweethearts of those fortunate enough to have them.

It is announced that "capital and labor will meet" at a convention that is to be held in New York at the rooms of the New York Board of Trade and Transportation, 203 Broadway, December 16 and 17, under the auspices of the Industrial Department of the National Civic Federation. A number of prominent manufacturers and representatives of labor organizations will be present and the general situation will be discussed.

New Corporations.

"Engineering and Mining Journal," of New York city; capital, $5,000. Directors: J. H. McGraw, J. M. Wakeman and F. J. Pratt, of New York city.

Stratton Motor Co., of New York city; capital, $150,000. Directors: E. F. Stratton and David Wood, of New York city, and G. H. Murray, Jr., of Hollis, L. I.

Rivoilier-Granger Velvet Machine Co., 419 Market street, Camden, N. J.; capital, $500,000. Incorporators: John McEdwards, Leander P. Randall and John S. Barham.

New York Metal Specialty Manufacturing Co., of New York city; capital, $10,000. Directors: A. W. Hoffman, Philip Harnischfeger and Adam P. Dienst, of New York city.

Tismer Speed Controller Company, of New York city; capital, $15,000. Directors: P. G. Tismer, of New York city; James West, of Brooklyn, and H. E. Knight, of Fanwood, N. J.

Hartford Annual Wind Clock Co., 525 Main street, East Orange, N. J.; object, manufacturing clocks, etc.; capital, $500,000. Incorporators: Alfred G. Brown, Albert R. Palmer and John R. Turner.

American Diesel Engine Co., of New York city; capital, $2,500,000. Directors: Alfred L. Curtiss, Mark Hyman, D. W. Morrow, Nathan A. Smyth, Graham Sumner, Harold Walker, of New York city, and J. Clinton Walker, of Brooklyn.

The American Vulcanized Fiber Co. (capital, $3,400,000) has been incorporated in Delaware. This is said to be a combination of all the fiber companies in the United States with the exception of two. The incorporators are: Richard B. Constance, Frank L. Arnold and C. Arthur Coon, of New York, and Gardner W. Kimball and J. Ernest Smith, of Wilmington, Del.

Manufacturers.

The Murphy Iron Works, Detroit, Mich., is building a new erecting shop.

An addition will be made to the Chattanooga (Tenn.) Plow Company's plant.

A new building is to be erected for the Toledo (O.) Metal Sign & Advertising Company.

Small & Norton, of Guilford, Me., are going to build a mill for sawing all kinds of lumber.

The Olympic Foundry Company, Seattle, Wash., has secured a permit for new foundry buildings.

A plant is to be built for the new Maryland Metallic Bedstead Company in Hagerstown, Md.

Work has begun on an addition to the Kennebec Worsted Company Ltd.'s plant, Philadelphia.

A new factory is being built at Attleboro, Mass., for the Attleboro Manufacturing Company, jewelers.

Ground has been broken for the Ohio Galvanizing & Manufacturing Company's new plant at Niles.

The McClave & Brooks Company, Scranton, Pa., will add to its plant shortly and will want equipment.

The Richardson Piano Case Co., North Leominster, Mass., will build an addition to its factory, 40x50 feet.

Architect C. G. Ogden has completed plans for a factory building for the Albany (N. Y.) Embossing Company.

Graif Bros.' flour mill at Lake Crystal, Minn., has been burned. It contained an electric light plant.

W. Vehs, backed by several capitalists, is promoting the erection of a beet sugar factory in Baraboo, Wis.

A new factory, 95x100 feet, will be erected for Young Bros., Detroit, Mich., manufacturers of sheet metal goods.

The works of the Cleveland Axle Manufacturing Company, Canton, O., have been partially destroyed by fire.

Holley, N. Y., residents have voted to issue bonds of $15,000 for constructing a municipal electric lighting plant.

A two-story brick condenser and scrubber house is being built to the Northern Liberties Gas Works, Philadelphia, Pa.

It is understood that the plant at Langhorne, Pa., of George Rumpf & Co., leather manufacturers, will be rebuilt.

A new water works system is to be established at Cameron, W. Va., bids for which will be asked for in a short time.

A machine shop is to be built by the Michigan Yacht & Power Company, 1524-1528 Jefferson avenue, Detroit, Mich.

The new steel plant of the Parkersburg (W. Va.) Iron & Steel Company is to be enlarged by a forge department, 110x225 feet.

Fire at 218 Centre street, New York, has destroyed some machinery belonging to the United States Electrical Chemical Company.

A new flask house is being built by the Southwark Foundry & Machine Company, Philadelphia, Pa., which will measure 36x54 feet.

The molding and pattern shops of the Dixie Plow Works, Richmond, Va., have been destroyed by fire. They will be rebuilt at once.

C. R. Makepeace, of Providence, R. I., is at work upon plans for an addition to the Whitman Mills, cotton goods, New Bedford, Mass.

A contract has been let for the new factory building at Bristol, Pa., of William H. Grundy & Co., manufacturers of worsted yarns.

The Port Huron (Mich.) Salt Company will spend between $100,000 and $200,000 in enlarging the plant and putting in new machinery.

The C. L. Flaccus Glass Company, of Pittsburgh, Pa., will enlarge its plant at Tarentum, Pa., so as to employ about 200 additional men.

A six-story factory, 50x98.9 feet, is to be erected by John Williams, manufacturer of metal goods, 556 West Twenty-seventh street, New York city.

A new angle mill will be built by the Carnegie Steel Company at its Homestead works, near Pittsburgh, Pa. It will be built on the continuous order.

The breaker of the Green Ridge Coal Company, Scranton, Pa., has been destroyed by fire, with boiler and engine houses, blacksmith and car sheds.

The St. Louis (Mo.) Iron & Machine Works are erecting a four-story pattern and machine storage house at 137 to 145 Chouteau avenue, to cost about $7,000.

P. & F. Corbin, manufacturers of hardware, New Britain, Conn., have decided to build an addition, 60 feet in width, about 200 feet long and seven stories high.

The Philadelphia & Lehigh Valley Traction Company is planning to erect a power-house at Sellersville to supply the line between Allentown and Chestnut Hill.

The main building of the Michigan Alkali Company's soda-ash plant at Wyandotte, 12 miles down the Detroit River from Detroit, Mich., has been burned.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant: see p. 24.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Eye Benders. Estep & Dolan, Sandwich, Ill.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N.J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Models, machinery and experimental work made and repaired. Messerer, 24 Boudinot st., Newark, N. J.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Special tools, models, fine light mach'y and foundry work wanted. Murray Mfg. Co., Richmond Valley, Staten Island, N. Y.

Fine machine, special tools and experimental work; inventions developed. The Des Jardins Company, Hartford, Conn.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, cut light gears, cams and duplicate small machine parts, in quantities.

Purchaser for small manufacturing plant; lot, 100x180 feet; machine shop, 32x68, two story, with line shaft and gasoline power; foundry, 40x54, new modern equipment; good location; for sale cheap. Hart-Parr Co., Madison, Wis.

Party with medium size, modern, up-to-date machine shop equipment, that can and will remove to another locality, can learn of an unusually good opportunity to form valuable associations by addressing, with details, "Permanent Business," care AMER. MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—Partner with capital, to engage in lucrative business, foundry and machine shop, central New York; excellent railroad shipping facilities and good field for repair work; salable products to manufacture; opportunity for earnest man desiring business of magnitude. Address "Experienced Mechanic," Box 272, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line